VOLUME 39 CHEMICAL & METALLURGICAL ENGINEERING NUMBER 5

ESTABLISHED 1902—MCGRAW-HILL PUBLISHING COMPANY, INC.
S. D. KIRKPATRICK, Editor

May, 1932

More Reason—Fewer Rackets

NEVER in the lives of most of us has it been so difficult to view the events of the day in their true proportion and perspective. The economic problems that now call for decision seem to transcend all others in significance and complexity. They apply not only to the nation but to business and professional groups as well. The chemical engineer cannot afford to withhold his influence and opinion on such matters, even though they may not always affect his daily work.

EMERGENCIES call for heroic measures, whether in balancing the national budget or operating a plant in the face of a disappearing market. But it is unfortunate that emergencies often call forth a flood of illogical and sometimes dangerous proposals. Rather than cut federal expenditures, Congress plays with fantastic schemes for taxes on beer and homebrew, lubricating oil and toilet waters. When finally forced to economize, the ax is ruthlessly applied to the Bureau of Standards and other agencies of the Department of Commerce that render vital service to industry. Another bonus bill or some new grant of pensions for widows and orphans holds the attention of important Congressional committees while measures affecting the whole credit structure of the nation are pigeonholed by vote-seeking politicians. Is it any wonder that industry looks forward hopefully to an early adjournment?

ONE of the most disturbing elements in the situation is the ominous rise of self-appointed reformers who choose such times as these to plague and hamper legitimate industry. Utterly lacking in perspective of the problems involved, they fight for legislation to correct some minor or alleged major practice they deem to be against the public interest. The cure is nearly always worse than the disease. This session of Congress has cost chemical industry many hundreds of dollars of needless expense in conferences and public hearings in order to convince the proponents of these measures of the hardships and absurdities which such legislation would involve. And the end is not yet, for there is a wide variety of poison bills and special labeling requirements yet to be heard from.

BUT NOT ALL of the industry's problems are confined to Washington. Just as unsound and dangerous proposals in the name of economy are being made in many companies. Instead of using this opportunity for reconstruction and the building of new business, some are resorting to rackets and trade practices that discredit the entire industry. Panic-stricken producers are being forced to sell their goods at less than cost. Dependable sources of supply are being destroyed by sharp practices on the part of the buyer. More than ever before, what is needed is courage to face the facts, and character to apply sound principles in our business and professional relations. The whole course of recovery is one of following the dictates of reason and common sense rather than the racketeer and ruinous reformer.

EDITORIALS

MAY, 1932

New York Appeals to The Chemical Profession

AT LAST we are beginning to make progress with the chemical unemployment and relief program in the New York area. Behind a united front a real effort is being made to do a job that might have been much further advanced had it not been for the pitiful lack of cooperation in certain high places. The committee, of which Robert T. Baldwin, of the Chemists' Club, is treasurer, realizes that its work has only started. At the end of the first week of May it had placed 93 men in permanent or temporary employment, while 358 qualified chemists and chemical engineers are still unplaced. Of these more than 60 are in dire need. Of the $15,000 required to carry the work until July 1, only about a sixth has been collected to date. The need is urgent and immediate. A contribution of a few dollars from each man who has a job today is all that is needed.

A Supreme Court For Medical Fact-finding

MANY industrial problems involving chemicals affect public health, safety of workmen, or other phases of public welfare. This fact is recognized by federal, state, and municipal laws, ordinances, and regulatory agencies. But there is no adequate coordinating influence for this control. There is no recognized authority to which one can go and obtain clean-cut scientific decisions generally acceptable both to federal officials and those in lesser jurisdictions.

The problems recently presented to the chemical industry in the proposal of a Volatile Poison Act, advocated by Professor Yandell Henderson, of Yale, and Senator Bingham, of Connecticut, are but a single example of the troubles which constantly are forced on our industry. In this particular case it was decided that the whole question should be referred to the Surgeon General of the Public Health Service for investigation, before any further legislation was attempted. This is a wise decision, and the Senate committee should be complimented on it. But can we expect similarly wise decisions in all of these matters, especially if emotional tension arises from some unfortunate accident? We should have a more general remedy for problems of this character.

The Surgeon General of the Public Health Service should be specifically authorized by law to investigate any cases where there is serious public danger resulting from packaging, labeling, distributing, or use of chemicals or other industrial materials. By inference from the present law, the Surgeon General seems to have this authority; but it is not frequently exercised. We believe a definite authorization to this end should be given and a clear responsibility placed on the Public Health Service.

The results of such investigation and finding by the Surgeon General would easily be enforced without any new or complicated laws or administrative agencies. If mailing of goods is involved, then it is simply necessary for the Postmaster General to accept and act on the Surgeon General's findings. If foods or drugs, insecticides, tea, or other like materials demand new treatment, new labeling, or new packaging, then under the Secretary of Agriculture there is already a going concern to do the work; namely, the Food, Drug and Insecticide Administration. Similarly, if "caustic poisons" are involved the administrator of the Caustic Poison Act would be guided by such decision. And so in other matters, present administrative agencies presumably would be adequate. All we need is a supreme court for fact finding as to the laws of nature and their human consequences in terms of safety and public well-being.

When Congress convenes next winter will be an appropriate time at which the industry should have a well-formulated program for presentation before the proper committees. Perhaps the Manufacturing Chemists Association will be the logical one to sponsor the movement. In any event, it should have the support of all chemical producers and consumers.

Wherein We Meet A Hardy Pioneer

A FEW weeks ago a sprightly young man of indeterminate years walked into these editorial offices and, by way of introduction, laid before us a marked copy of *Chem. & Met.* for May, 1910. He pointed to one of Dr. Roeber's editorials, which began as follows: "Mr. Ernest A. LeSueur, who twenty years ago was the pioneer of the diaphragm cell for sodium chloride electrolysis. . . . " Our first reaction was one of surprise to find Mr. LeSueur so well preserved and hardy a pioneer. But we were even more surprised to learn that his original invention, developed more than forty years ago, has been carried on continuously and on a large commercial scale since 1897. This, in spite of the fact that a recent commentator—so well qualified, for example, as Dr. Mantell, in his new book on "Industrial Electrochemistry"—somehow fails to record the fact that the LeSueur cell or any other of the horizontal submerged diaphragm type has a place in the American industry today. The simple truth is that an installation in Berlin, N. H., is daily producing 50,000 lb. of chlorine and almost 60,000 lb. of c.p. caustic soda, at a time when many banks of cells in many plants have been shut down for badly needed rest and repair.

Mr. LeSueur's story interested us immensely. While still a student at M.I.T.—in fact yet in his teens—he developed an electrolyzer with a suspended mercury cathode which produced a very strong solution of pure caustic soda. His first commercial cell, developed in 1890, was a compact, 180-amp. unit, requiring less than 5 volts for its operation. After some months of testing and a year or so spent in interesting capital, ground was broken for a plant at Rumford Falls, Me., in 1892, and the current turned on during the following year. Then came five hectic years of costly experiments in which many changes were made, only to have the LeSueur cell emerge as an economical and efficient unit, in the main an elaboration of his original 1890 type.

Like many others, however, who would revolutionize a great world industry without adequate funds, the Electrochemical Company of Boston could not weather the financial storms of 1898. It was bought by the Burgess Sulphite Fibre Company (predecessor of the Brown Company), and the plant transferred to Berlin, N. H., where it has been a striking commercial success from the very start. Much of the credit for that is undoubtedly due to the contributions of others, notable among them being Charles B. Barton, plant superintendent, whose record of continuous employment in the electrolytic caustic soda industry probably is greater than that of any other man in this country. (He started in September, 1894 and is still going strong!) In 1920, when he recounted to the American Institute of Chemical Engineers some of his early experiences with commercial electrolytic cells (see *Trans. A.I.Ch.E.*, Vol. XIII, part 1, pp. 5 ff.), he said: "Unless I am greatly mistaken these patents [referring to LeSueur's patents granted in 1891] were the foundation of all electrolytic porous diaphragm cells, and credit should be given to E. A. LeSueur as being the real founder of the industry." That must come, perhaps from older heads than ours, but *Chem. & Met.* welcomes an opportunity to pay its respects to this hardy pioneer and to congratulate him on the robust survival of his now 35-year-old progeny.

Chemical Industry's Struggle Overseas

WITH Europe moving inavertibly to a dire economic reckoning and her American industrial ties still in growth, the annual spring reports from abroad assume an increasing significance. In the chemical field, the outstanding 1931 summaries are offered by the reports of I. G. Farbenindustrie and Montecatini, and the competent Department of Commerce bulletin on "German Chemical Developments," formerly by W. T. Daugherty, and this year by W. L. Lowrie. Industrial hardship never really abated on the Continent after the War, but only since 1929 has it betrayed its portentous gravity, now reflected in these documents. To those who doubt its general importance, the conclusions of the Bank of International Settlements at Basel on May 10 will be enlightening.

Chemical operations, through their diversification, fared better on the Continent than general industry. In Germany, outpost of chemistry, this became accentuated temporarily, but with every indication of early change. Thus chemical industry bettered its favorable trade position, exports falling only 15 per cent (by value) in 1931, against 26 per cent for imports. This was a result of the national crisis last year, but the inevitable external readjustment (currency devaluation, tariffs, embargos) is forcing German chemical industry to the general low level. And external competition by innumerable small protected industries is helping to create an *impasse* to chemical trade generally. The emergency 10 per cent reduction of wages and prices (January, 1932) can have effect only until other nations catch up with it.

Among the few companies still operating profitably, the I.G. reports a dividend of 7 per cent, against the 4½ of the British I.C.I., but compared with 12 per cent in the past. Its capitalization is to be reduced by $27,500,000; and its payroll during 1931 sank from 79,963 employees to 68,022, many of whom are now on part time. Greater detail will be found on the news pages of this issue, but it should be noted here that the I.G. could make a comparatively good showing only because of its policies of diversification, research, international agreement, and lack of indebtedness to banks.

Actually the unbalance in European affairs is typified by the nitrate deadlock. Potash, rayon, petroleum products, coke, ammonium sulphate, dyes—all are available in quantity in many countries: Russia is even producing one-third of Germany's pre-war output in potash! The Leuna plant is largely idle; Chile fights for its existence; every small country has a nitrogen plant of its own; and the only effective stabilizing agreement was terminated last summer.

The I.G. has found security in cooperation with Montecatini, the I.C.I., the Far East, and previously with various American groups. With the general but unpredictable readjustment still portending, it is hopeful to see a similar impenetration of interests and products across the Atlantic, as yet resisting trade barriers. On the one side American firms are involved in the German petroleum, plastics, electric precipitation, and magnesium industries; on the other, Germany consumed American carbon black, borates, sulphur, phosphate, benzol and naval stores to the value of $10,258,000 in 1931. And the mutual stream of new research developments seems only to have grown in the depression.

Mathews Honors Richards' Memory

TEN YEARS have elapsed since the death of a man to whom many of us owe a deep and lasting debt. The part that Prof. J. W. Richards played in the founding and early development of the Electrochemical Society and, incidentally, of this journal, is a chapter in the history of chemical industry already known to many of our readers. That the first Joseph W. Richards Memorial Lecture should be given by one of his electrometallurgical colleagues was altogether appropriate. Dr. John A. Mathews, vice-president and chief metallurgist of the Crucible Steel Company, in his address on "The Electric Furnace and Alloy Age," paid a well-deserved tribute to an old and inspiring friend. May inspiration continue to spring from the memory of a courageous insurgent who led the way for independent thinking and action in a field that has continued to benefit from it.

Sulphate Pulp Industry Founded On Sweden's Resources

By G. HALL
Technical Adviser
Svenska Cellulosa Aktiebolaget
Östrand, Sweden

SWEDEN has at its command unusual opportunities for creation of a large industry for utilization of wood. The area of the country's forests equals the total area of Great Britain, and a network of rivers offers means of transportation of timber and water power for the industry. These opportunities, combined with the necessity of balancing her foreign trade, have built the industry for utilization of wood products till it represents about half of Sweden's total exports.

A combination of different branches of the industry, such as the manufacture of sawed lumber, cellulose, and charcoal, has made possible a rational use of the lumber, with the result that practically everything inside the bark has been utilized. The Swedish forests usually consist of coniferous trees, mainly two species, the Norway spruce (*Picea excelsa*) and Scotch pine (*Pinus sylvestris*), in about equal proportions. In chemical composition the pine contains about two to three times as much resin as the spruce. For this reason the two varieties require different processes for dissolving the lignite which serves as binder of the cellulose material in the wood. Therefore the so-called sulphite process is used for the spruce, whereas the pine, on account of the higher resin content, requires the sulphate process, a little more costly in consumption of chemicals.

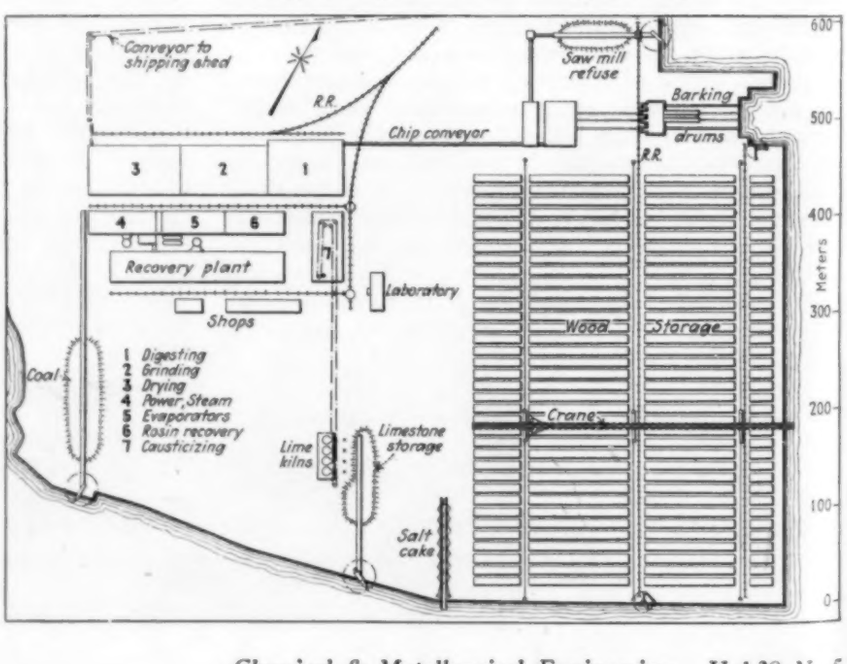
Pine lumber of large dimensions goes to the sawmills, and the smaller cuttings, together with sawmill scrap, serve as raw material for the sulphate plants. The spruce is sent to the sulphite or to the mechanical grinding plants, both of which handle only spruce. Finally, all top and larger branches, which are too small for economical transportation, are burned in the forests to charcoal, which is used by the iron industry for production of high-quality steel.

Structure of Pulp Industry

Sweden is a long, narrow country, sloping from the higher plateaus in the west toward the Baltic and the Bothnic Sea in the east. The northern part, Norrland, is cut by a series of parallel rivers, the source of which is in the mountains on the Norwegian border and which flow eastward toward the Bothnic Sea. The favorable transportation on them and cheap power have led to the construction of new cellulose plants at their mouths during the last 20 years. Several important industrial centers have thus been created on the eastern coast, most important of which is that near the city of Sundsvall.

When Svenska Cellulosa Aktiebolaget was formed two years ago, factories in the Sundsvall district served as nucleus for the undertaking, and five sulphite plants in this district were absorbed, giving a combined annual productive capacity of about 200,000 metric tons of sulphite cellulose, and with important holdings of forest lands in the districts for which the Ljungan and Indal rivers serve as the natural outlets. The concerns, however, did not own any sulphate plants in this region to take care of the excess of pine wood from these forests. Prior to the formation of Svenska Cellulosa Aktiebolaget plans had been in existence for building a large sulphate plant in the Sundsvall district by cooperation among the individual companies operating in the district, and these plans took form quickly when the various plants became

Layout of Sulphate Pulp Plant Seen on Opposite Page



consolidated financially into one concern. This was the start of the new large sulphate plant at Östrand described here.

The Östrand plant is now the largest sulphate plant in Europe. The first ground was turned in April, 1930, and in December, 1931, operation of the initial section was started. The plant is divided into four sections with a total annual capacity of 100,000 long tons of sulphate cellulose; equipment for three sections with 75,000 tons capacity has been installed. Early this year the third section was put in operation.

For a plant of such large dimensions the use of much expensive labor-saving machinery and transportation equipment has been found economical, which might not have been advisable for a smaller plant. As a result, the entire operating personnel comprises 300 men.

Pine wood consists of about one-half fiber and one-half other organic material, which must be dissolved so that the fiber may be utilized. Formerly this was done by heating the wood under pressure with a mixture of sodium hydroxide and sodium sulphide, but later it was found that a stronger fiber was obtained by the use of sodium sulphate.

New Kraft Pulp Plant at Östrand
Photos Courtesy of Swedish-American News Exchange

Preparing the Wood

The wood supply of the plant is partly lumber (full-size trunks) and partly scrap from sawmills in the vicinity. A 10-ton crane is used for handling the wood from the lumber yard, which has an area of 120,000 sq.m. The crane, with a total width of 300 m., runs on three tracks and is powered with synchronous motors. One man is required for its operation. A cab runs along the beam across the traveling direction of the crane, permitting service of every spot in the yard.

The lumber is carefully stored in piles for drying and for sorting. To permit a solid foundation for the crane the three rails are placed on concrete ties, which again are placed on rows of strong reinforced concrete piers, driven to bedrock. About 10,000 piers have been used for this purpose, each weighing 4 to 5 tons.

While the pine is already barked in the forests, before it is floated to the sea coast, a small quantity of the inner bark is left on the lumber, and this interferes with a cellulose of highest purity. To loosen this inner bark Östrand has gone to a large and expensive installation of barking drums working on a new principle, the so-called "long-barking." The logs are fed automatically into a 34-m. long drum, which rotates partly submerged in water, and as the logs rub against each other the bark is removed. Because the drums, which are about 3.5 m. in diameter, have a slightly conical shape, the logs are gradually moved toward the discharge end and fall into a pool of hot water. From this pool, acting as a storage, the logs are transported to a mill where they are cut into chips.

Scrap from the sawmills is chopped to chips at these mills before being transported to the sulphate plant on barges. A large crane unloads these barges to a conveyor which transports the material to the so-called "cleaning plant." To produce a cellulose of good quality the chips should be of as even a size as possible; they are therefore passed through large rotating screens where the oversize as well as the fine material is removed.

Digesting Plant

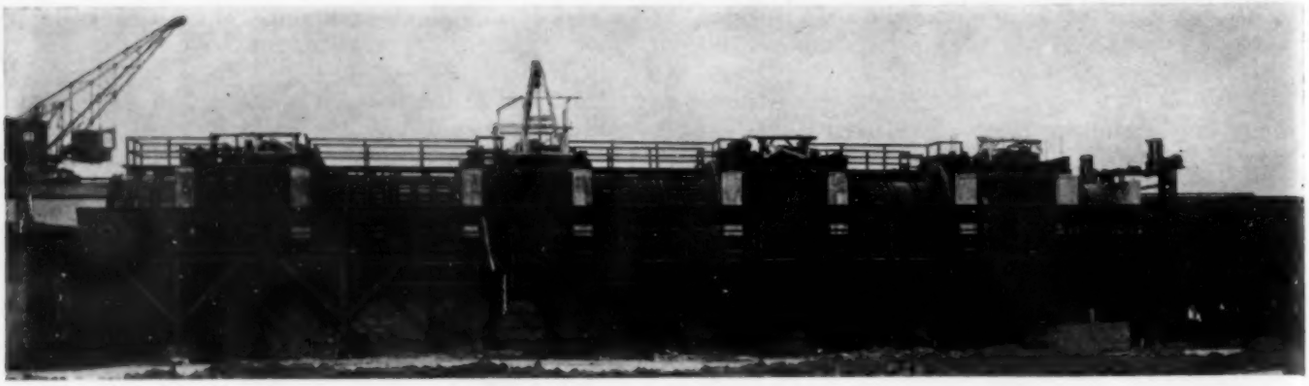
From the cleaning plant the chips are taken on belt conveyors to bins at the top of the digesters. A large building 240x50 m. contains the digesters, filters, Chilean mills, and a paper room.

The digesting plant is the central point of the operations. An old maxim among paper men, "the paper is made in the beaters," might be paraphrased to "the cellulose is made in the digesters," because the treatment in these determines the quality of the fiber in the cellulose. At present this plant has 12 digesters of 100 cu.m. capacity, to which later will be added four more of the same size when the plant is brought up to the annual capacity of 100,000 tons. As a result of the large digester volume the treatment may be carried out very carefully with a slow increase in temperature, thus protecting the fibers and preserving their maximum strength. All digesters are equipped for indirect heating with forced circulation of the liquid.

After completion of cooking the fiber must be separated from the liquid with the dissolved organic substance, maintaining the liquid as concentrated as possible on account of the subsequent evaporation to recover the chemicals. This is done in the diffusion apparatus; large cylindrical containers of 90 cu.m. volume, 30 in all, placed in three rings of ten each. Foul-smelling organic products form during the boiling, especially mercaptans, the odor of which has a tendency to cling to the fiber. To render the cellulose as odorless as possible, the washing is done with fresh water, which is preheated with the steam obtained in emptying the digesters.

To produce a high quality cellulose, a large supply of fresh water is important, which Östrand obtains from a large reservoir at the Indal River, 4 km. from the plant. The quantity of water used is sufficient to supply the city of Stockholm during the summer months, when the consumption is at a maximum (120,000 liters per minute). The water is purified in the pump station through continuous filters.

When the mass is completely freed from all liquid,



New Type Barking Drums, 34 M. in Length, 3.5 M. Across

it is pumped over to the filtration department, where it is first freed from all knots, which do not dissolve. This is done in rotating knot catchers, the so-called "Haug pre-sorters." The main filtration of the mass, to remove impurities and small undigested particles, is done in a battery of rotating screens.

Swedish sulphate pulp has for a long time been called "Kraftmassa," or only "Kraft," an expression which has become known in the paper industry all over the world. The word "Kraft" means "strength," and to obtain real strength the wood should be cooked only so long that a large part of the fibers remains in bunches held together by some undissolved liquid. For this reason a real kraft pulp generally appears quite uneven to the eye. Therefore it is now treated in Chilean mills to dissolve the bundles of fiber. A Chilean mill consists of two heavy stones, rotating on a horizontal axis and rubbing the mass against the bottom, as shown in the accompanying illustration. To obtain a good efficiency the mass should have a solid content of 18-20 per cent and the thin pulp from the sieves therefore is thickened in Oliver filters. The plant has a battery of 60 Chilean mills, arranged in units of 10 each. With full capacity the number will be increased to 80. The mills in each unit are interconnected by screw conveyors, transporting the mass automatically from one mill to the next. By this arrangement one man handles the entire section, and the mass is moved automatically through the entire system.

The most interesting technical innovation at the plant is the drying apparatus. Up to this time the cellulose has generally been made into sheets, and these sheets have been dried, by using drying machines which in construction and operation are closely related to the multiple-cylinder paper machines. Cellulose drying machines have thus consisted of a wet part, an endless metal cloth in combination with a series of presses to form and press a continuous sheet of cellulose, and a drying part consisting of a large number of steam-heated cylinders.

New Drying Methods

In the new Östrand machines the wet parts remain unchanged, but the drying is radically changed, as the mass is dried in a stream of hot air in a gigantic drying box instead of directly against the steam-heated cylinders. In this way a better steam efficiency is obtained and, what may be even more important, a better quality of fiber. With common cylinder drying a rather high temperature must be maintained in the drying cylinders to remove the water from the entire layer of mass, with the result that the mass nearest to the cylinders easily becomes overdried. However, in the new dryers, constructed by A/B Svenska Fläktfabrikken, the mass is dried with hot air at a lower temperature, and the entire mass is dried effectively at the same time. The lower temperature and the even rate of drying preclude any danger of overdrying the fiber and the "wet properties" of the mass are better preserved. In this manner fiber strength as well as solubility is gained.

In regard to the construction of the new dryers, the drying section resembles a large box divided in a number of horizontal sections. Each section has a conveyor and a heating battery. The conveyors run in opposite directions in alternating sections, and the wet material, entering the lowest section from the wet part of the dryer, is moved by the conveyors in zigzag through the dryer up to the upper section, where it is discharged with the desired moisture content. The moist, hot air leaving the dryer passes through a separate recuperator, where primary air is preheated.

Two dryers based on the same principle have previously been tested at other plants, and the three large dryers at Östrand, each about 4 m. wide, have functioned perfectly from the start. Each has an annual capacity of about 25,000 tons of air-dried pulp.

All the dried pulp is again to be moistened and dissolved by the buyers in the various countries before it is made into paper. Under such circumstances expensive drying does not seem a logical procedure, but

Chilean Mills Grind Pulp Fibers

the question of transportation cost enters here. Where transportation cost does not prevent it, many paper manufacturers desire to receive the mass in a wet, or rather a semi-dry, state. To permit flexibility according to the demand, the plant has one separate "wet" machine for production of a 50-per cent dried mass. This unit has an annual capacity of about 25,000 tons (dry basis).

When the pulp is dried or treated on the wet machine, it is cut in sheets and baled in hydraulic presses. The finished bales are placed on an automatic conveyor and taken to an elevated conveyor which transports them to large warehouses at the docks. The company has made ample provisions for loading and shipping by building a wharf 250 m. long, dredging to 25 ft. to permit loading of ocean steamers.

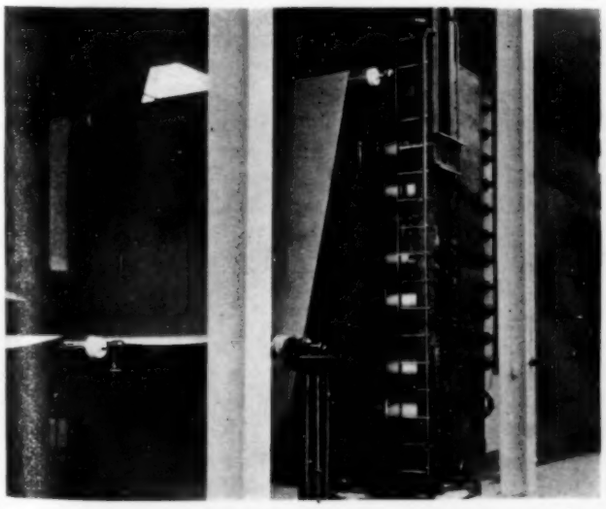
The plant site is on a railroad with spurs to the different parts of the plant, as shown in the accompanying plan. Ocean transport usually is precluded during the winter months, and the plant then has the opportunity to ship its product south by rail. Large warehouses, permit storing of about 25,000 tons.

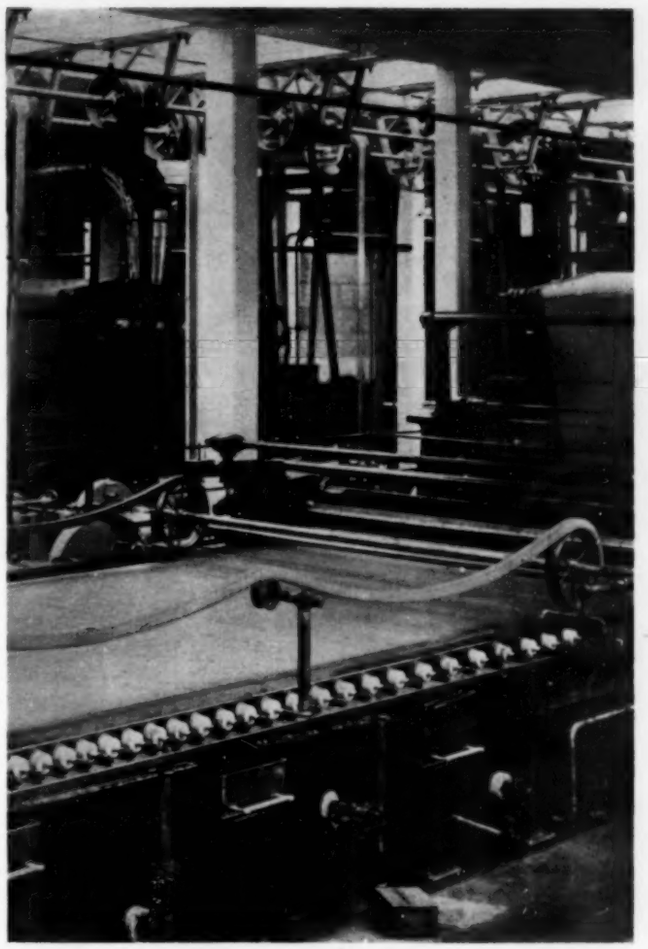
Byproduct Disposal

As already stated, recovery of the chemicals is essential in the sulphate process. The waste, or "black liquor," which was removed in the diffusion apparatus, is evaporated by a continuous process in a quadruple-effect evaporator, consisting of four heat elements, each having 650 sq.m. capacity. In the evaporation plant each last unit works under vacuum, and the liquor is concentrated from 10-12 deg. Bé. to about 25 deg. It is then pumped to the soda house, where the final evaporation and calcination is carried out in rotating furnaces and blast furnaces. Ahead of the blast furnaces the quantity of sodium sulphate necessary to make up for unavoidable alkali losses is added, and this is reduced to sodium sulphide in the smelting furnaces. The alkali has at the same time been converted into inactive sodium carbonate. After solution of the fused chemical from the furnace in water, it is causticized with burnt lime.

It is interesting that the valueless and bothersome byproduct thus obtained, precipitated calcium carbonate, will be utilized in the alcohol factories with Svenska Cellulosa Aktiebolaget operates in connection with four of its sulphite plants in the Sundsvall district. The waste liquor from the sulphite plants contains some fermentable forms of sugar, which are easily converted into alcohol and thus constitute a valuable byproduct. Prior to fermentation the liquor must be neutralized and this offers an opportunity to use the lime sludge.

Pulp Emerging From New Drying Machine





Wet End of Drying Machine

Östrand has a modern power station with a 10,000-hp. DeLaval turbine aggregate. In a pulp plant, steam of varying pressure is needed for digesting and drying; this has been procured in a satisfactory manner by combining a counter-pressure turbine and a condensation turbine to one aggregate, a counter-pressure and bleeder turbine of 7,000 hp. at one end, and a condensation turbine of 3,000 hp. at the other end. From the former, steam of 10 atm. pressure is drawn to the digesting plant, and steam of 2 atm. pressure to drying machines and evaporating plant. The initial pressure is 25 atm., a pressure used generally for the large coal-fired steam-plate installation as well as for the steam-plate installation in the soda plant, which is fired with residual matter, obtained from the wood by evaporation.

As Svenska Cellulosa Aktiebolaget has consolidated the production of some 300,000 tons of sulphite, 225,000 tons of sulphate and 200,000 tons of mechanical pulp, a modern control laboratory has been built at Östrand, partly to aid the individual plants in their efforts to produce pulp of high quality and partly to aid the sales organization in its technical contact with consumers in the various countries. This laboratory is fully equipped to permit all regular testing required in the pulp and paper industry, as well as for scientific investigations.

Careful Installation Pays in Plant Piping

By FRED D. HARTFORD
Engineer
Denver, Colo.

MOST ENGINEERS will have observed a tendency among producers of materials or processes to glorify themselves by declaring that civilization has dated from the hour their particular material or process appeared. The steel people, for example, are prone to proclaim that civilization was merely marking time until the day that Bessemer and Kelly blew air through molten iron to produce cheap steel. The makers of the screw-thread tools say that industry was virtually at a standstill until someone cut a thread on a pipe or a rod. And although chemical men modestly admit that civilization has leaned heavily on their industry, yet they confess that the success of their own business has depended to a great degree on the developments of another industry —that of pipe manufacture. As the arteries and veins are indispensable to the life of human beings, just so is piping indispensable to the life of the chemical plant.

Piping as a means of cheap transportation is a possibility in almost every field—ashes, sawdust, cement, or molten metals, for instance, are quite as readily conveyed by piping as are ordinary liquids and gases. At the same time piping is the most flexible of all conveying systems, for whether it be laid uphill, downhill, or around corners makes no difference. The possibilities of piping justify a critical study of each proposed installation to secure the maximum utilization of all its good qualities.

The designer of chemical plants today is fortunate in having a wide variety of piping materials from which to choose. Steel, wrought iron, cast iron, silicon iron, lead, aluminum, nickel, brass, copper, rubber, glass, fused silica, wood, and vitrified clay are all familiar to him. Makers of alloys of various sorts also offer piping suited to specific needs including such materials as: Monel metal and the alloys of iron with copper, chromium, molybdenum, and nickel. Lined pipe also is a possibility for some purposes. The designer is rarely limited to one sort of piping for any particular service. Usually he must weigh first cost, mechanical strength, life, maintenance and the quantity of impurities that will be introduced by the corrosion of the pipe itself, to secure the most economical installation.

Careful Selection Must Rule

Too often force of habit or precedent rather than sober study is the rule in selecting pipe materials. For example, a section of steel piping may be replaced time after time until someone puts in cast iron or silicon iron, perhaps, and the trouble disappears. Chemical men are frequently persuaded to install various sorts of metallic piping on the basis of so-called "accelerated" tests. They usually find that the piping fails to stand up as well as the test indicated it should. Unless an accelerated test keeps the sample or the corrosive agent in violent agitation, then it fails to imitate the scouring action ever present in the piping used in chemical manufacture.

And last but not least, the designer should realize that there is a *fitness* of piping to the nature of the job under discussion. Piping suitable for a laboratory model, or even a pilot plant, may be utterly unsuited to the day-in and day-out service of a regular plant. For example, in one installation a diluent was added to strong sulphuric acid through a delicate glass tube inserted through a cast-iron blank flange. Muddy conditions required the frequent removal and replacement of this blank flange, an operation that invariably resulted in the breakage of the glass tube. At last the superintendent replaced the glass with a piece of silicon-iron pipe of substantial proportions, which defied the most earnest efforts of the pipe-fitter helper to break it, and at the same time resisted the corrosive action.

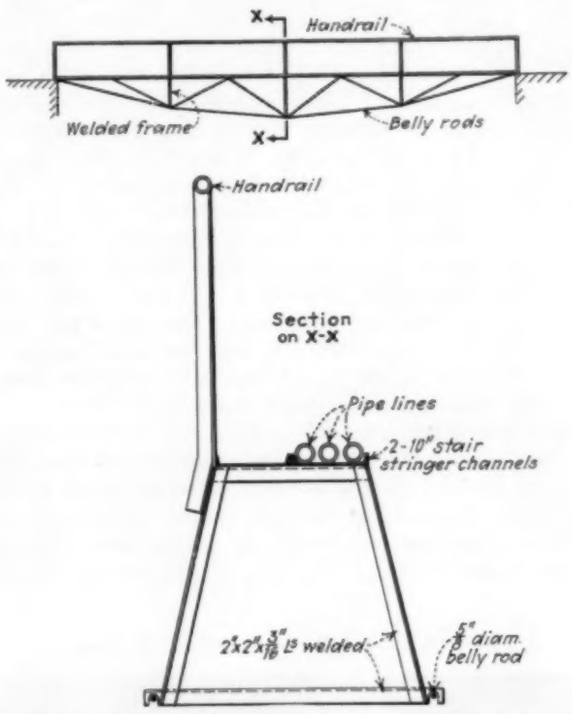


Fig. 1—Side Elevation and Cross-Section of Pipe Truss With Walkway and Space for Several Pipes

Pipe Joints Are Critical

Usually the joints between pipes or fittings are the critical points in a piping layout. For example, the traditional piping for carrying muriatic acid is composed of pieces of glass tubing some 5 ft. long, connected by short pieces of rubber hose wired or clamped around the tubing. The plant man is worried far more about the

failure of the rubber joint than he is about the breakage of the fragile tubing.

Steel pipe has been found economical for conveying sulphuric acid of 60-deg. Bé. concentration and stronger, although such pipe fails at the threads in a relatively short time. With power threading machines, the pipe man is tempted to cut the threads too deep and too long, thus making the pipe vulnerable at this point. Threads should be cut just deep enough to make a tight joint

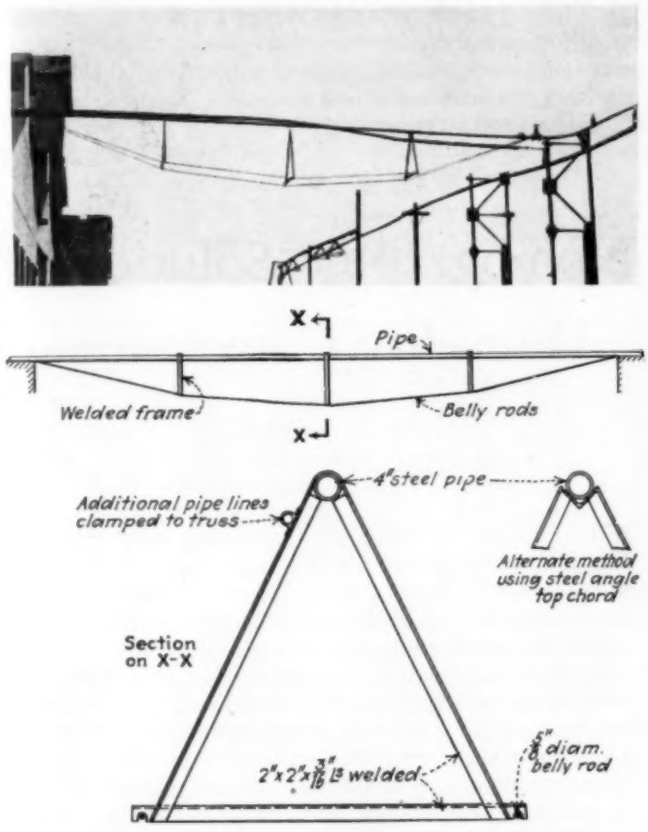


Fig. 2—Economical Single-Pipe Truss, Shown in Elevation and Section; Additional Pipes May Be Supported by Attaching to Top Pipe or Truss Frame

without reliance upon any thread compound. Reaming the ends of the pipe should be done sparingly. The use of extra-heavy pipe corrects in some degree this weakening of the pipe at the threads.

For many types of pipe joints, welding furnishes the best solution. The metal at the joint can be made any desirable thickness, in contrast to the weakening of the joint caused by thread cutting. Too, bends may be made with any desired angle; branches can be taken off at any point; and the time of the shutdown is frequently materially shortened. For extensive employment of welded chemical pipe lines the use of suitable welding rods, machine-beveled pipe ends, long-sweep fittings, and clamps or jigs for holding the pipe in position while welding should all receive careful attention if efficiency is to be secured. Welding is sometimes condemned because of failure to observe these essential elements.

When new piping is to be installed, it is often somewhat difficult to decide whether it should be put overhead or underground. Both methods have advantages as well as disadvantages. The advantages of placing piping overhead are:

1. Easy inspection for workmanship and leakage.
2. Piping readily available for repair at any point.
3. Freedom from the corrosion usual underground.

The disadvantages of placing piping overhead are:

1. Exposure to freezing and variations in temperature.
2. Exposure to mechanical injury.
3. Danger to passers-by if the pipe bursts.

The advantages of placing piping underground are:

1. Piping does not occupy valuable space.
2. Low cost of installation.
3. Protection from mechanical injury and freezing.

The disadvantages of underground piping are:

1. Difficulty of detecting leaks and pipe deterioration.
2. Difficulty of repair, especially where there is ground water.
3. Corrosion of the exterior of the piping by ground conditions or by chemicals which have leaked from adjacent piping.
4. Salvage value usually not equal to its cost.

One of the disadvantages of overhead piping is given above as: "Danger to passers-by if the pipe bursts." This danger in reality applies equally to underground lines. I was once walking with a gang of men in a chemical plant when a 2-in. underground lead line carrying chamber acid under pressure burst near-by, spouting the acid geyserlike into the air. Luckily no one was injured, but each man who saw the accident was impressed with the fact that such failures can be a real hazard to human life.

A pipe tunnel such as is commonly used for steam is not ordinarily to be recommended for piping carrying corrosives. Leakage, which is virtually certain with chemical lines sooner or later, would make repairs difficult and, in addition, might cause serious damage to the tunnel structure should it become flooded. When piping must pass under certain obstacles—for example, under a concrete roadway or under a shallow stream—it may be placed inside of a vitrified tile pipe so as to be withdrawn readily for replacement.

Overhead Piping Supports

Having decided, for example, that we should carry our yard pipe lines overhead, how shall we arrange the supporting structure? Certainly not by a messenger cable and hangers, for the cheapness of this scheme is overbalanced by the difficulty of installation and of repair. Sometimes it may be possible to carry elevated piping by brackets attached to buildings, but in general the overhead structure will consist of independent posts or towers with beams or trusses between.

In designing such structures the clearance and the gradient are primary considerations. The headroom required over railroad tracks usually is 22 ft. and may need to be more to accommodate locomotive cranes. Plant roadways or power lines also may require consideration. Overhead piping should be set on a grade to drain in order to facilitate repairs and to avoid air pockets or low places which may freeze or permit sediment to be deposited.

Having decided on the height of our piping above the ground, how shall the spans be proportioned—frequent posts and short spans or fewer posts and longer spans? In general the most economical arrangement is obtained when the total cost of the uprights equals the cost of the trusses. However, buildings or other structures or obstacles along the line will frequently determine the location of the uprights.

These uprights may be ordinary wood poles, steel

pipes, latticed steel posts, or braced steel towers, depending on the height and the loads to be carried. In general it should be said that rigidity is more important than mere load-carrying capacity. For example, a light steel tower well braced is less expensive than a single solid column of equal rigidity.

The trusses supporting the piping between uprights take many forms. These trusses, besides supporting the pipe, should, where possible, also carry a walkway. One of the simplest trusses for carrying a number of small lines as well as providing a working platform is shown in Fig. 1. It consists of one or two steel stair-stringer channels laid flat and trussed with rods underneath. These channels may be either the standard rolled sections or $\frac{3}{16}$-in. plates bent into channel form. Ordinarily, the length of such a span should not exceed 40 times the width—25 is better. The channels may be welded or bolted together and the trussing welded solid underneath so that the span is placed in one piece. Such a support is especially suitable for glass, hard-rubber, fused-silica, vitrified-tile, or silicon-iron piping.

For single lines of large, heavy pipe, steel trusses fabricated specially are usually required. A particular feature of such trusses should be to allow the piping to be swung up into place with the least amount of work. In other words, the piping should be set between or below the trusses rather than placed above them. It should be remembered that such trusses are most economically braced in the plane of their top chords and, if possible, the piping should not interfere with such bracing.

When single lines of steel pipe 2 in. and larger are used, then an especially economical form of bracing may be arranged whereby the pipe itself forms the top member of a triangular truss frame. Fig. 2 shows a cross-section and elevation of typical spans which may be readily built 60 ft. or more in length. Other lines of pipe may be clamped to the top pipe or laid along the sides of the truss frame. It will be noted that the truss rods themselves form a good foothold for painters or repair men. The use of extra heavy pipe on all such installations usually is advisable. Somewhat similar construction consists in using a steel angle for the top chord as in the sketch of the alternate method.

Since long runs of overhead piping require special attention to provide for expansion and contraction, the supporting structure should allow for similar movement. This can be provided for by swinging or sliding devices, but better yet by routing the pipe line so that each straight run does not exceed, say, 100 ft. in length. Suppose, for example, a pipe line is to be run 500 ft. north and 500 ft. east of a certain starting point. Rather than to make two straight runs of 500 ft. each, it would be better, usually, to zigzag in shorter lengths across the plant. Then the supporting structure as well as the pipe line itself might be welded solid from end to end, allowing the expansion to be taken care of by slight bending at each change in direction of the pipe. Provision for expansion and contraction is especially important when hot liquids are run intermittently.

In addition to the foregoing general considerations, there are several other single items of importance in installing piping. For instance, when repairing an acid line which may contain pockets of acid held back by sediment, the workmen should be instructed to stay above the piping, for each time a joint is broken acid might otherwise pour out into a man's face. I know of a case where a man stood on a ladder to take off a blind flange on a line of supposedly dry gas piping. After removing all the bolts, he struck the flange with a hammer to loosen it and was greeted by a stream of hot oleum that drenched his neck and shoulders.

Lines of piping in a building are sometimes placed so close together or so near the wall that it is impossible to use a wrench on them. Again, piping is sometimes run through latticed building columns or through building trusses making repairs extremely difficult.

Welding on steel acid piping should not be permitted until the line and any tanks connected with it are thoroughly ventilated. In one plant where this regulation was not observed, a hydrogen-filled pipe exploded, driving the torch into the welder's skull and splitting the pipe from end to end.

▼ ▼ ▼

Nomographic Solution of Humidity Conversions

By D. S. DAVIS
Appleton, Wis.

SEVERAL methods of expressing humidities and percentage humidities are in general use and some confusion exists as to the distinctions between them. Mechanical engineers have long dealt with the somewhat archaic units of grains of water vapor per cubic foot of air and have clung tenaciously to the concept of percentage relative humidity, which may be defined as the ratio of the weight of water vapor contained in any given volume of air to the weight of water vapor present in the same volume of saturated air, all values referring to the same temperature. Saturated air at 140 deg. F. contains 56.5 grains of water vapor per cubic foot and thus air at the same temperature, which contains but 25.7 grains of water vapor, is said to have a relative humidity of 25.7/56.5 × 100 or 45.4 per cent.

Chemical engineers, on the other hand, are using the more convenient "absolute humidity" which is the ratio of the weight of water vapor to the weight of dry air in which it is contained, and are very sensibly using the same units of weight for both the water and the air, so that absolute humidity is a dimensionless ratio, although it usually appears on psychrometric charts as pounds of water vapor per pound of dry air. Tests on the partially saturated air of the previous example would show it to have an absolute humidity of 0.0605, and since the absolute humidity at the saturation point is 0.1514, the percentage absolute humidity is 0.0605/0.1514 × 100 or 40.

This situation is similar to that encountered by the chemist in handling solubilities. Indeed, since humidities are really solubility values with water as the solute and dry air as the solvent, it follows that percentage relative and percentage absolute humidities are analogous to percentage solubilities on the "liter-of-solution" and the "gram-of-solvent" bases, respectively. At 15 deg. C. a saturated aqueous solution of NaCl contains 317.0 grams of salt per liter of solution; and thus a solution which contained but 142.5 grams of salt per liter of solution at

the same temperature could be said to have a "relative solubility" of 142.5/317.0 × 100 or 44.95 per cent. Another way of expressing this is to say that the same partially saturated solution contains 0.1494 grams of salt per gram of water at 15 deg. C. and that the saturation value at this temperature is 0.3575 grams of salt per gram of water, making the percentage "absolute solubility" 0.1494/0.3575 × 100 or 41.79.

In this analogy the salt corresponds to the water vapor and the water to the dry air, while grams of salt per liter of solution, whatever the specific gravity, corresponds to grains of water vapor per cubic foot of air, whatever the humid volume. In addition, the number of grams of salt per gram of water corresponds to the absolute humidity in pounds of water vapor per pound of dry air; and percentage relative and absolute solubilities correspond to percentage relative and absolute humidities.

A need for a method of handling conversions between the two humidity systems is evident and has prompted the development of several conversion charts, notably that of Lavine and Sutherland (*Chem. & Met.*, **36,** 1929, p. 425) and that of Monack (*Chem. & Met.*, **38,** 1931, p. 718). Both, however, are subject to two disadvantages: first, in their construction they require the careful plotting of a number of curves which are parabolic or hyperbolic in nature, and second, in their use they necessitate the interpolation of values between lines of rapidly changing curvature.

There is need for a conversion chart which will be simpler to prepare and easier to read. A nomograph will meet these requirements satisfactorily since it is a familiar property of the nomographic chart that curves are reduced to straight lines, or to a single curve, and that all interpolations are made along graduated axes. It is the purpose of this paper to present such a nomograph and to illustrate its use.

The equation connecting percentage absolute humidity, H, with percentage relative humidity, R, is

$$H = \frac{B - p}{B - Rp/100} R \qquad (1)$$

where B is the barometric pressure and p is the vapor tension of water at the temperature in question. Equation (1) may be written as

$$\frac{HB}{R} - \frac{Hp}{100} = B - p$$

and if S is made equal to $\frac{HB}{R}$ so that

$$\frac{R}{B} = \frac{H}{S} \qquad (2)$$

the original equation becomes

$$S - \frac{Hp}{100} = B - p$$

which, in turn, may be written as

$$\frac{p}{100} = \frac{B - S}{100 - H} \qquad (3)$$

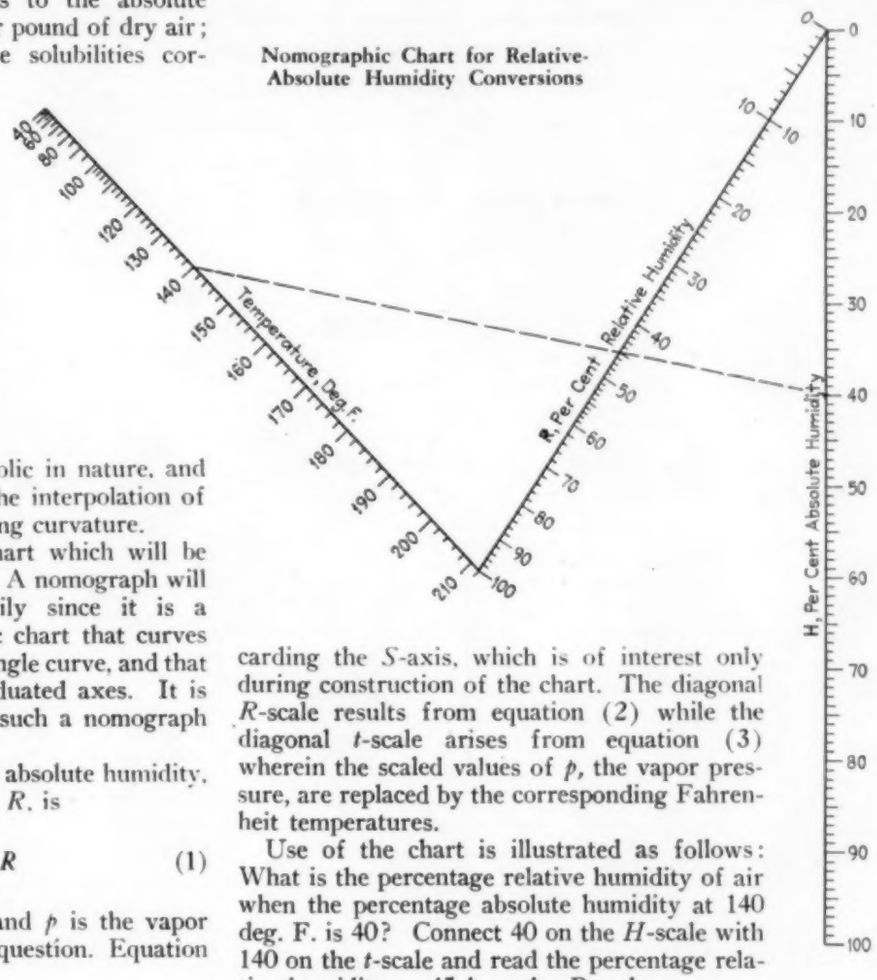
Equations (2) and (3) are seen to be of the form

$$f(x) = \frac{F(y)}{\varphi(z)}$$

and each can be charted in the form of an N-type nomograph, a discussion of which has been given elsewhere (Davis, *Paper Ind.*, **13,** 1931, p. 1101).

Suffice it to say here that when B and p are expressed in millimeters of mercury, a chart of a convenient size results from the use of unit representations or moduli of 0.3 and 0.05 cm. for the H- and S-axes, respectively, in the case of both equations (2) and (3), superimposing the charts for the individual equations and finally discarding the S-axis, which is of interest only during construction of the chart. The diagonal R-scale results from equation (2) while the diagonal t-scale arises from equation (3) wherein the scaled values of p, the vapor pressure, are replaced by the corresponding Fahrenheit temperatures.

Nomographic Chart for Relative-Absolute Humidity Conversions



Use of the chart is illustrated as follows: What is the percentage relative humidity of air when the percentage absolute humidity at 140 deg. F. is 40? Connect 40 on the H-scale with 140 on the t-scale and read the percentage relative humidity as 45.4 on the R-scale.

As stated by Monack, inspection of equation (1) shows that H is indeterminate when $t = 212$ deg. F. and $R = 100$, that for any value of R except 100, H is zero at 212 deg. F., and that when solved for R as in

$$R = \frac{BH}{B - (1 - H/100)p}$$

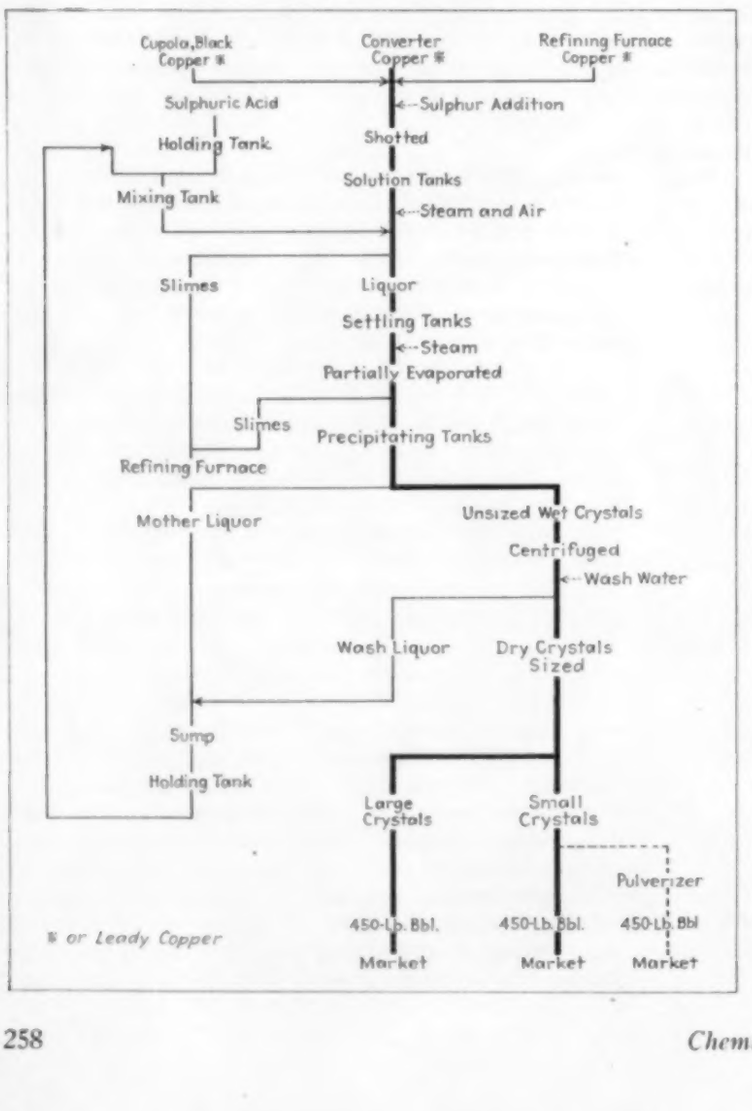
equation (1) indicates that $R = 100$ for all values of H at 212 deg. F. These points are all brought out very nicely by the nomograph: the t- and R-axes intersect at $t = 212$ deg. F. and $R = 100$, so there is nothing to give direction to an index line when t and R have these values, making H indeterminate. For any value of R except 100, the R-axis becomes the index line when $t = 212$ deg. F., making $H = 0$. Further, all indices drawn from any point on the H-scale to the point $t = 212$ intersect the R-axis only in the point $R = 100$.

Blue Vitriol Produced By Leaching Shot

The process consists in leaching metallic copper in the form of shot with dilute sulphuric acid. It is based upon the fact that gold, silver, lead, antimony, arsenic, and some other metals, such as those of the platinum group, are insoluble

By PIERCE BARKER
Metallurgical Engineer
Detroit, Mich.

Flow Sheet of Copper Sulphate Production



MOST copper sulphate is produced in the United States as a byproduct of electrolytic copper refining; however, it is also manufactured by chemical companies and occurs as a byproduct in parting gold and silver in smelting operations concerned with the refining of other metals. A small quantity results from lead smelting where copper-bearing lead matte is produced. No attempt should be made to manufacture copper sulphate alone, as it is not economical. Its advantage lies in being a byproduct where overhead and manufacturing costs are absorbed by the other products of the plant, and its operation results in freeing from the copper shot valuable metals in the slime.

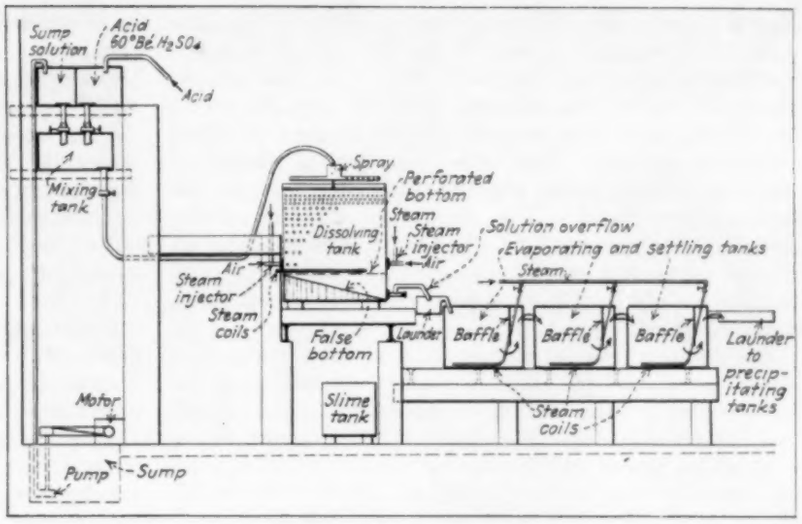
The trade demands a firm, solid crystal which must be free from any porous spots containing dilute acid of the mother liquor. Crystals must be pure—99.0 per cent or better—and possess a good sky-blue color; greenish tints are not permitted, as they indicate high iron. The larger crystals usually command a slightly higher price than the smaller, or fines. In order to obtain pure crystals, the solution of copper sulphate must be not only clean and free from slimes and other foreign substances but also of high enough concentration to insure deposits upon cooling. The manufacturer generally has demands for large (plus ½ mesh), and small (minus ½ in. mesh), and sometimes for pulverized crystals. Where faulty crystals are made they may be pulverized if a demand for such a product exists.

The production of copper sulphate by the method to be described consists in oxidizing the metal as rapidly as possible and putting the oxide in solution in the least quantity of sulphuric acid while providing opportunities for any impurities to settle out before the precipitation portion of the cycle is reached. We may consider that the production takes place in a cycle of eight major periods: (1) oxidation of the copper, (2) solution of the oxide in dilute sulphuric acid, (3) settling out of impurities, (4) concentration of the clear solution, (5) precipitation of the copper sulphate by crystallization, (6) washing and drying of the crystals, (7) sizing, and (8) packaging.

Copper must be in the form of shot to provide the maximum surface for oxidation and solution. The shot is porous with a surface made up of irregular kidney shapes and cracks

which are obtained by using copper with a sulphur content of about 4 per cent. Cracks aid the penetration and oxidation of the shot in the dissolving tank.

Where the copper shot is derived from the converter, it is purposely not blown to a complete sulphur elimination previous to shotting. Where it is derived from a copper-refining furnace, sulphur may be introduced by melting in either copper sulphide or copper matte, and also by using petroleum coke for a cover when refining. Petroleum coke alone will not introduce sufficient sulphur for shotting, but it assists the effect desired. Black copper from a cupola may also be used, but it must be remelted, usually with scrap copper and sulphur introduced as above. Scrap copper, too, is sometimes utilized as a source of bluestone.



Schematic Diagram of Plant Producing Copper Sulphate by Action of Sulphuric Acid on Copper in the Form of Shot

Shots are formed by pouring the copper in a controlled stream either against a rotating cone or cylinder, or from a board rolled back and forth on a pipe. The copper spatters into a metal basket placed in a pit of water at 180 deg. F. The basket is perforated on the sides, but not on the dished bottom.

Oxidation of copper and solution of the oxide take place in a lead-lined circular dissolving tank. Fifteen tons of shot is placed in the tank, filling it to within a few inches of the top, and the sulphuric acid mixture is sprayed over the shot through a rotary spray. The mixture is led to the center cup through the lead feed pipe and escapes through two radial perforated pipes, which causes them to rotate and sprinkle the acid. Meanwhile live steam is forced into the mass through two injectors. Using injectors with the steam allows air to assist the oxidation of the metal. The necessary heat is supplied by a steam coil placed over the perforated false bottoms and the shot is heated to 180-200 deg. F., which has a drying action on the sulphuric acid mixture sprayed at the top of the tank.

The air taken in by the injectors is wet with steam, which tends to dilute the acid spray, but this is more than offset by its action as an oxidizing agent, which increases the yield of copper oxide, which in turn is soluble in the dilute sulphuric acid. Reasonably dry steam should be used in the process, and if possible it should be generated in furnace flue boilers as a by-product, if economical manufacturing costs are to result. The oxidation is further increased by allowing the steam in the coil and injectors to operate continuously.

The spray is stopped at the end of the day's operation, and the mother-liquor sulphuric acid mixture is dried on the shot by the heat and air from the coil and the two injectors, forming a coating of copper oxide and some sulphate. The greatest quantity of oxide is formed during this oxidation period at the time of drying of the salts on the shot, which lasts 15 hours or more.

In mixing the 60 deg. Bé. sulphuric acid with the mother liquor from the precipitating tanks and washings from the centrifugal machine in the mixing tank preparatory to spraying it over the copper shot, it is essential that the acid be controlled and an excessive quantity not be used. The gravity of the mixture should be about 28 deg. Bé. at 52 deg. F. A greater gravity may be obtained by the use of more acid, but an excessive quantity will not increase the rate of solution of the copper and will produce porous crystals filled with dilute acid as the final product.

The process of oxidation and solution in the dissolving tank will not take place with sufficient rapidity until the sprayed solution of sulphuric acid is built up in copper sulphate to the quantity of at least 20 grams per liter of copper and 250 grams of sulphuric acid.

After the drying of the salts on the shot, previously referred to, has progressed sufficiently—usually 15-18 hours—the mother-liquor sulphuric acid mixture is again sprayed on the shot and the cycle repeated. This is continued as long as the copper sulphate liquor leaving the tank is of the right gravity.

The first liquor coming from the solution tanks is heavy in copper sulphate; this diminishes as the oxide and sulphate salts are gradually consumed from the surface of the shot. After the solution has flowed 3 or 4 hours over the shot, it is so weak in copper sulphate that it is no longer economical or practical to continue it over the tank, and another solution tank must be started and the former one put on the oxide period of the cycle. The formation of the copper oxide from the action of the air and steam is so slow that it does not keep up with the rate of solution flow over the shot; hence the liquor leaving the tank becomes too lean in copper sulphate for precipitation. The tank is then said to be "dead."

A dissolving tank will last about four weeks of continuous operation alternately on the oxidation and solution portions of the cycle, after which time it becomes so loaded with slime that the rate of percolation and solution is too slow and it should be cleaned. Also the shot

Table I—Typical Figures for Solution Control

Solution to	Copper Grams per Liter	Iron Grams per Liter	H_2SO_4 Grams per Liter
Dissolving Tank—27° Bé. at 52.5° F.	23	1.5	269
Settling Tank—34° Bé. at 72° F.	80	2.0	100
Precipitating Tank—39° Bé. at 80° F.	113	3.0	198
Sump—21° Bé. at 33° F.	27	2.2	118

becomes coated with lead sulphate, resulting in too slow a rate of oxidation. A man flushes the shot with a fire hose having good water pressure, to free it from slimes, which are mostly lead sulphate with lead and any previous metals which were originally in the copper. He then shovels it out onto a platform. The flushed slimes are caught in settling tanks and the water overflows to the mother-liquor sump. The slimes are allowed to dry partially after settling, and the mud is either treated in a cupel furnace if it contains precious metals, or if it contains mainly lead, it must be returned to a lead blast-furnace charge.

The dissolving vessel consists of a circular tank. Six triangular shaped pieces of wood are placed upon the bottom, and a false bottom is nailed on. The whole tank is then lined with sheet lead. Six triangular pieces of wood are placed on the false bottom, so that the channels between lead to the overflow; seven lead-covered strips are placed upon these to support the perforated bottom, which is made of lead with holes drilled every inch. Upon the perforated bottom, a lead pipe for steam is laid, which is allowed to exhaust inside the tank.

Six inches above the perforated bottom is an injector made of lead and operated by 75 lb. steam pressure, which introduces air into the tank for oxidizing purposes. Injectors are placed, one front and one back, 180 deg. apart, one slightly higher than the other. The overflow has an offset pipe which acts as a seal. A wooden plug causes the overflow to pass through the offset pipe, sealing the steam in the tank by maintaining a level of solution above the slime clean-out.

Settling and Crystallizing

Settling and precipitating tanks are made from boards lined on the sides and bottom with lead. This type of tank is the most economical; in the case of puncture from digging crystals it may readily be repaired. If the wooden tanks are painted inside and out previous to lining with three coats of acidproof paint, they will last for about ten years.

The liquor leaving the oxidation and solution tanks passes through a launder to the top of the settling tanks. And in order for the solution to leave the tank it must pass under the baffle located at the overflow and carry the heavier liquor, thus preventing segregation of the heavy liquor at the bottom with the slimes settled out. The rate of flow is not sufficient to stir up the settled sediment, and in passing upward it mixes with and also displaces the heavy liquor already in the tank. The first tank will have the heaviest sediment of impurities, while those after the third will have hardly any. All slime, insoluble sulphates or metallics, and dirt which have been carried from the dissolving tank will settle in these tanks; hence the liquor leaving them is freed of impurities which would otherwise be entrained in the copper sulphate crystals, if they reached the precipitation tanks.

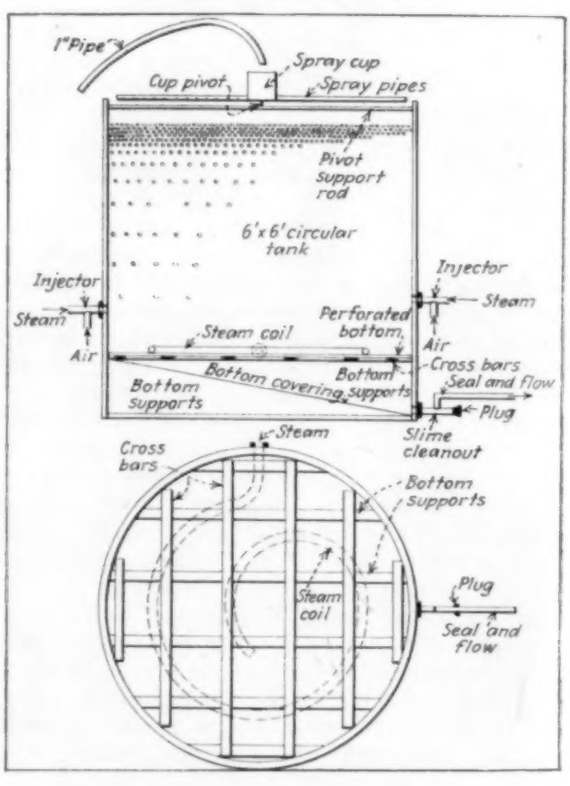
It is essential to provide sufficient settling-tank volume to allow a large evaporation ratio. This is the reason for providing at least six, and preferably eighteen, settling tanks where large production is desired. These are provided with coils, and during the oxidation period in the solution tanks there should be no liquid flow through the settling tanks (the manufacture of copper sulphate is distinctly a cycle of intermittent periods; where continuous operation is required, duplicate sets of solution and settling tanks must be provided). Steam is kept on continuously in these tanks, and during the oxidation in the solution tanks a simultaneous period of evaporation takes place in the settling tanks. During the solution period, the liquor heavy in copper sulphate flows to the settling tanks and gradually displaces the liquor in them. At the end of the filling period for the precipitating tanks, the settling tanks contain liquor of almost the same gravity as that which left the solution tanks. During the evaporation period this liquor is concentrated, but as long as the steam is kept on and the temperature maintained, crystals do not form.

To insure continuous operation, the same number of crystallizing tanks must be filled as are pulled for crystal production. Hence a greater evaporation capacity permits a greater number of tanks to be pulled for crystal production.

It is advisable to have eight crystallizing tanks to every one solution tank. The shallow precipitation tanks are arranged in rows, resting on acid-proofed timbers or concrete acid-proofed supports. The precipitating strips are either lead or copper. The strips are hung on planks laid across the 5-ft. width of the tanks. The lead or copper strips are equally spaced on the planks. There are nine rows of strips, 15 strips per row, making 135 strips per tank. The strips reach to within 1 ft. of the bottom of the tank. They should not touch the bottom; otherwise they will become imbedded in the bottom crystals and will be impossible to remove without extra labor of releasing the strip and bottom crystals, in which the strips become firmly held. The maximum number of strips are placed in the tanks in order to get the greatest precipitating areas.

Upon removing the crystals from the tank, which provide four to five barrels of 450 lb. per pull, they are immediately hoisted to the centrifuge floor, for washing. The crystals are washed with a water spray for 15 to 20 seconds; a minimum quantity of water is used to

Oxidation and Solution Tank Is the Heart of the System



give an acid-free dry crystal product. They are whirled dry for a period of 3 to 3½ minutes. A centrifuge with the motor mounted on top, which may be swung back on a hinge when changing the basket, is convenient. This type is mounted on a three-rod suspension which is really a ball and socket tripod. The motor is connected to the basket through a combined clutch and brake. In loading the centrifuge basket, the crystals must be evenly distributed; otherwise, bumping results.

The wash water, which contains a small percentage of copper sulphate, is collected in the sump tank and helps increase the mother liquor, which later, with added sulphuric acid, is used for solution of the copper oxide.

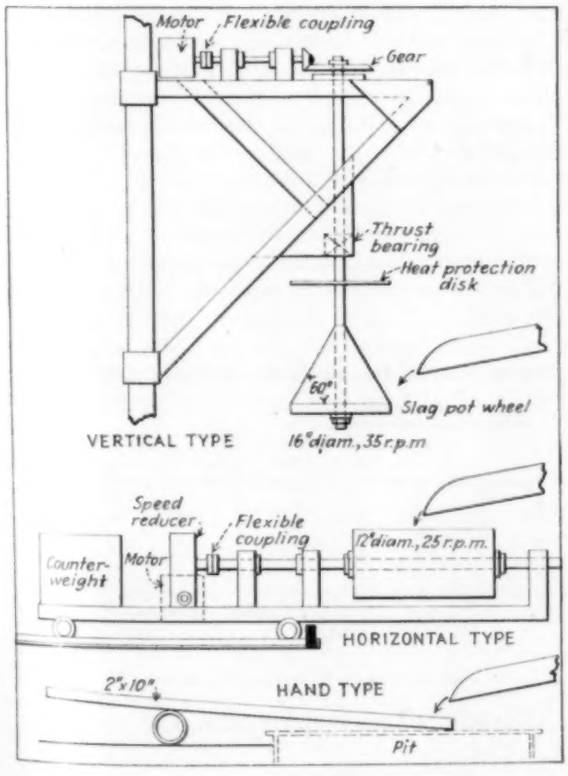
Plenty of ventilation for the cooling of the crystallizing tanks is required, so that the solution may cool at a uniform rate. It takes five days for a tank to cool and precipitate completely. In the summer months, unless good ventilation is provided, it will take six or seven days for complete precipitation. In any event, it is best to allow six or seven days for complete precipitation by providing sufficient precipitating capacity so that the cycle may be maintained on this basis; it is uneconomical to circulate any more copper in solution than is necessary.

The crystals are delivered from the centrifuge to a trommel where sizing is effected. All crystals which are oversize for a ½-in. screen are designated as coarse crystals, while those below this size are fine crystals. For insecticide work, dry pulverized crystals may be required, in which case the minus ½-in. mesh crystals may be pulverized direct; or if there is a demand for small crystals elsewhere, these will be sized at the washer and a minus ⅛-in. mesh crystal produced for pulverizing. The Ross type pulverizer is excellent for this purpose.

Copper sulphate should be barreled immediately after washing and sizing, as it is efflorescent, losing its five molecules of water of crystallization, and turning white upon exposure to the air. The barrels usually are clean sugar barrels holding 450 lb. of large sulphate crystals. Sometimes where trade demands exist, no sizing is done; the whole is barreled as small crystals, particularly where no price difference is allowed.

The steam required will be a 50-hp. boiler for three 6x6-ft. dissolving tanks and 40 precipitating tanks. In other words, a horsepower per precipitating tank plus ten for line and other losses for 200-300 ft. of steam travel. It is well to allow 20 hp. per dissolving tank and twelve precipitating tanks per dissolving tank. Steam pressure is 50 lb. minimum at the tanks. The labor required for a 300-bbl. a week plant will be seven men.

Three Types of Equipment for the Formation of the Shot



▼

Trichlorethylene Used In Plating

A "VAPOR DEGREASER" employing trichlorethylene as the solvent has been substituted for the alkali cleaners, which are objectionable on account of the alkaline film remaining and adhering to the steel surface, in chromium plating at the Frankford Arsenal, Philadelphia, Pa., according to A. Willink, in his paper on chromium plating of steel for wear resistance at high temperature and high current densities, presented before the Electrochemical Society, Baltimore, Md., April 23, 1932.

Cleaning prior to chromium plating is something that should be given considerable study. It is believed that practically all the failures in chromium plate due to chipped plate are due to the existence of an alkaline film on the surface of the work. When this film is eliminated, an adherent plate will be obtained in practically every case. In order to eliminate greases, oils, and the like from the surface, it has been common practice heretofore to use an alkali cleaner of some sort (sometimes an electrolytic cleaner). If great caution is not exercised, an alkaline film can very easily remain on the work, causing subsequent poor adherence of the chromium plate. It is believed that an acid dip following the alkali cleaner is in itself entirely satisfactory. The alkaline film can, however, be eliminated by cleaning by inverse current in chromic acid, but this procedure is sometimes impracticable.

A method of cleaning which has found considerable favor at the Frankford Arsenal has been the use of a vapor degreaser and the entire omission of alkali from the cleaning operation. The vapor degreaser is a device for evaporating trichlorethylene, and this vapor condenses on the work and dissolves all grease which drops off to the bottom of the tank. The trichlorethylene is then re-evaporated and used over again. It is prevented from coming out of the tank by means of a water-cooled condenser just below the upper edge. The results of the use of the vapor degreaser have been quite gratifying. Another advantage of this type of cleaning lies in the fact that the work, as it comes out of the degreaser, requires no rinsing and is ready for immediate immersion in the chromium bath. Its temperature at the time it reaches the bath is approximately that of the bath and perhaps a little higher, thereby preventing any local cold solution from surrounding the work, which will cause a "burnt" plate as the current density is high.

Constructing Vessel for Gas-Liquid Reaction

By BERNARD KRAMER

Mechanical Engineer, Pittsburgh, Pa.

SPRINGING is a term descriptive of blowing CO_2 gas through a bath of sodium phenolate or sodium cresolate to form either sodium carbonate and phenol, or sodium carbonate and cresol. Both the sodium carbonate and the phenol or cresol remain in liquid form and may be separated by gravity. The following description represents the writer's experience in improving a springing operation in a simple and inexpensive manner.

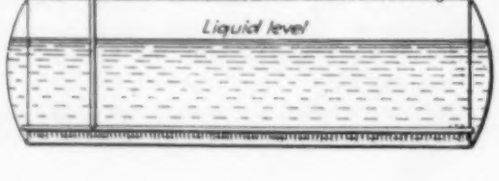
The CO_2 gas was obtained from the flue of one or two lime kilns. After going through a dust-catcher, washer, and water separator, the gas was picked up by a gas compressor and sent through the bath, which consisted of two horizontal tanks 9 ft. in diameter by about 30 ft. long, having a 4-in. standard pipe laid along the bottom. The pipe had perforations along its under side, and the gas discharge from the pump was supposed to bubble through the phenolate or cresolate, filling the tank to about 75 per cent of its capacity (see Fig. 1).

The results obtained left much to be desired. Up to 50 per cent of the CO_2 gas going through the phenolate or cresolate bath escaped without reacting, and in general the process was sluggish, showing evidence of poor contact between gas and liquid.

As the capacity of the plant was being more than doubled, it was decided that the springing operation must be improved and extended. There was another horizontal tank available of the same size as the two then in operation, and it was suggested that a vertical tank or tower be erected and supported over the three horizontal tanks. This vertical tank was to be filled with hurdles, and a recirculating pump installed so as to be able to recirculate phenolate or cresolate from any of the three horizontal tanks over the hurdles in the vertical tank or tower, from the bottom of which the liquid could flow back by gravity to any of the horizontal tanks. The CO_2 gas was to flow through the horizontal tanks and the vertical tower in series, in any order desired.

This undoubtedly would have improved the contact between gas and liquor, but there were several objections to this scheme: (*a*) Expense—Purchase and maintenance of an extra pump; purchase, support, and erection of a new tower, hurdles, etc. (*b*) It would take a high friction head to send the CO_2 gas through the four tanks in series. The gas compressor was quite ample for that, but the gravity backflow from the vertical tower to any of the horizontal tanks would have to be provided with deep seals. These might prove to be a constant source of trouble and annoyance. (*c*) A springing operation, unlike an absorption process in a scrubbing operation, should not require any hurdles or recirculation. When a gas is being partly or wholly taken into solution by a liquid, recirculation and spraying over hurdles would help to make the scrubbing medium more concentrated up to the point or saturation. But in this case the reaction is purely chemical, the CO_2 gas replacing the phenol or cresol. Recirculation in such a process was regarded of little use, if any.

Fig. 1—Original Springing Tank



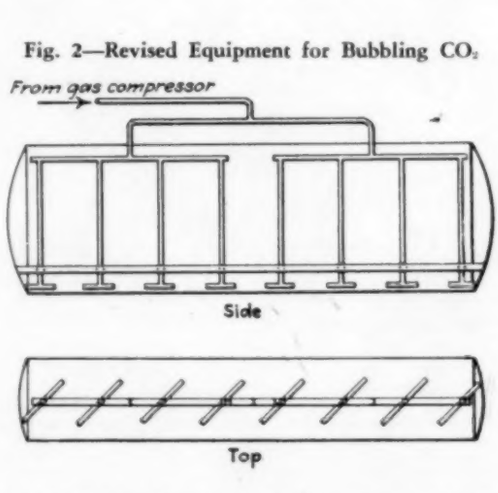
After investigation the writer suggested some simple improvements in the present springing arrangement of the three horizontal tanks, based on the mechanism of the process. As mentioned above, the springing pipe was 6 in. above the bottom of the horizontal tank, and had $\frac{3}{8}$-in. holes drilled in a row at 1-in. centers along the under side; about 350 holes in all. The area of a 4-in. pipe is only about 112 times the area of a $\frac{3}{8}$-in. hole. Evidently the CO_2 gas never reached anywhere near the end of the perforated pipe, but bubbled through the holes in about one-third of the pipe nearest the joint. Another consideration is that gas globules blowing through a $\frac{3}{8}$-in. hole were too large and therefore were rising to the surface of the liquid without a good chance of coming in intimate contact with it for a complete reaction.

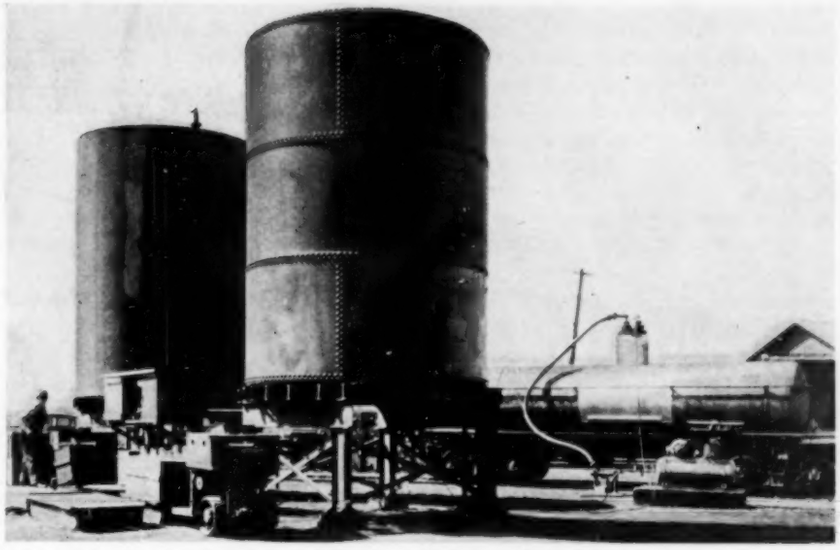
To overcome this objection $\frac{1}{16}$-in. holes were decided upon. But as it is difficult to drill such small holes in a pipe having a wall thickness of $\frac{1}{16}$ to $\frac{1}{4}$ in., it was suggested that slots $\frac{3}{8}$ to $\frac{1}{2}$ in. wide be cut, and that strips of regular perforated sheet metal be welded over them. For better and more equal distribution of the CO_2 gas all along the tank, the headers, manifolds, perforated pipes, etc., were arranged as shown in Fig. 2. It was thought that with this arrangement the contents of the entire tank would become thoroughly agitated, and every particle of gas brought in contact with the liquid.

The CO_2 gas is blown through the three horizontal tanks in series; and to assure using up as much of the CO_2 in the flue gas as possible, it was arranged to have the last pass through fresh phenolate or cresolate. By a loop arrangement of piping, the gas could be made to pass through the tanks in any order by the proper manipulation of some valves. Also any one of the three could be shut out of the series and allowed to separate into sodium carbonate and phenol or cresol.

This arrangement has now been in operation for the better part of a year and has proved entirely satisfactory.

Fig. 2—Revised Equipment for Bubbling CO_2





Rubber-Lined Storage Tank (on Left) and Tank Car for Hydrochloric Acid

Where Rubber Can Be Used for Equipment Construction

By H. E. FRITZ and J. R. HOOVER

The B. F. Goodrich Co.
Akron, Ohio

▼

CONTRASTING strangely with the liveliness exhibited in the physical reactions of rubber, we find in respect to chemical reactions a distinct lethargy, an inertia, which renders the material of unique value in certain engineering applications. It is apparent, when the manifold uses of rubber as a chemical resistant material are studied, that its value in the majority of cases depends not only upon the chemical inertia and peculiar physical properties of the basic substance but also upon the fact that this basic substance has been intelligently combined with a variety of other materials. Too much emphasis cannot be placed upon the fact that rubber compounds are designed for specific uses and can be bonded satisfactorily to many other structural materials.

This article is a summary of data pertinent to the application of rubber compounds in resisting corrosion or avoiding contamination. Such data should be of service to engineers who are confronted with the selection of materials for uses where corrosion of equipment or contamination of product are involved.

While unvulcanized fine Para and pale crepe rubbers have been and to a limited extent are still used as corrosion-resistant linings in chemical storage, process, or transportation equipment, the great bulk of rubber applied to chemical service is vulcanized. The present discussion will be confined, therefore, to vulcanized rubber.

When the conditions of service are accurately known by the manufacturer, vulcanized rubber can be compounded to resist actual immersion for long periods in any of the inorganic acids except those of strong oxidizing character. The same is true of nearly all inorganic salts and alkalis and to a lesser degree of commercial organic materials.

It should be clearly understood that the accompanying table was drawn up with the application of rubber to chemical process equipment chiefly in mind. For service where the requirements for long life are less severe, where slow diffusion of gas or vapor through the rubber, or contamination of product through discoloration, taste, or odor are not serious factors, soft rubber may often be substituted where hard is indicated; or some degree of chemical resistance may to advantage be sacrificed in the design of the compound, in order to gain certain desirable physical characteristics not otherwise attainable.

In many industrial uses rubber is thus subjected to chemical or solvent action or temperature conditions a great deal more severe than can be conservatively recommended for storage or process tank linings, which must remain unaffected and adherent to the base structure for years.

The outstanding exceptions to the general chemical

Based on the article, "Chemical Resistance of Rubber as an Engineering Material," presented before the A.S.T.M. Cleveland regional meeting, March 9, 1932.

inertia displayed by properly designed rubber compounds toward inorganic materials are nitric acid, concentrated sulphuric acid, chromic acid, and the dry halogens. In the organic field, we find that rubber is swollen and deteriorated—in various degrees to be sure, depending upon both the material considered and the design of the rubber compound—but nevertheless adversely affected by nearly all liquid fatty acids, drying oils, cyclic aliphatic liquids, and aromatic solvents. Especially severe are the effects of such solvents as benzene, carbon tetrachloride, ethylene dichloride, and carbon bisulphide, the latter being the worst. Mineral oils and greases seriously affect most soft rubber, but are satisfactorily resisted by true hard rubber and by some flexi-

Chemical Resistance of Rubber Compounds

	Concentration by Weight	*Maximum Temperature °F.*	*Degree of Vulcanization*	*Design of Compound*
1. Solutions of Inorganic Acids				
Arsenic acid	Any concentration	150	Soft	Specific
			Hard	General
Carbonic acid	Up to saturation at atmospheric pressure	150	Soft or hard	General
Chlorine water (hypochlorous acid)	Up to saturation at atmospheric pressure	100	Soft	Specific
		150	Hard	Specific
Fluoboric acid	Any concentration	150	Soft or hard	General
Fluosilicic acid	Any concentration	150	Soft or hard	General
Hydrobromic acid	Any concentration	100	Soft	Specific
		150	Hard	Specific
Hydrofluoric acid	Up to 50 per cent	150	Soft or hard	General
Hydrogen sulphide water	Up to saturation at atmospheric pressure	150	Hard	General
Hydrochloric acid	Any concentration	150	Soft or hard	General
Phosphoric acid	Up to 85 per cent	150	Soft	Specific
			Hard	General
Sulphuric acid	Up to 50 per cent	150	Soft or hard	General
Sulphurous acid	Up to saturation at atmospheric pressure	150	Hard	Specific
2. Solutions of Inorganic Salts and Alkalis				
Aluminum chloride	Up to saturation	150	Soft or hard	General
Aluminum sulphate	Up to saturation	150	Soft or hard	General
Alums	Up to saturation	150	Soft or hard	General
Ammonium chloride	Up to saturation	150	Soft or hard	General
Ammonium hydroxide	Up to saturation	100	Hard	General
Ammonium persulphate	Up to saturation	100	Soft	General
		150	Hard	General
Ammonium sulphate	Up to saturation	150	Soft or hard	General
Barium sulphide	Up to saturation	150	Soft or hard	General
Calcium bisulphite	Up to saturation	150	Hard	Specific
Calcium chloride	Up to saturation	150	Soft or hard	General
Calcium hypochlorite	Up to saturation	150	Soft	Specific
			Hard	General
Sodium hydroxide	Up to saturation	150	Soft or hard	General
Potassium hydroxide	Up to saturation	150	Soft or hard	General
Copper chloride (cupric)	Up to saturation	150	Hard	General
Copper cyanide (in solution with alkali cyanides)	Up to saturation	150	Soft or hard	General
Copper sulphate (cupric)	Up to saturation	150	Soft or hard	General
Ferric chloride	Up to saturation	150	Soft	Specific
			Hard	General
Ferrous sulphate ("copperas")	Up to saturation	150	Soft or hard	General
Nickel acetate	Up to saturation	150	Hard	Specific
Plating solutions: Brass, Cadmium, Copper, Gold, Lead, Nickel, Silver, Tin, Zinc	.....	150	Soft or hard	General
Potassium cuprocyanide	Up to saturation	150	Soft or hard	General
Potassium dichromate	Up to saturation	150	Hard	General
Sodium (or potassium) antimonate	Up to saturation	150	Soft or hard	General
Sodium (or potassium) bisulphite	Up to saturation	150	Hard	General
Sodium (or potassium) acid sulphate	Up to saturation	150	Soft or hard	General
Sodium (or potassium) chloride	Up to saturation	150	Soft or hard	General
Sodium (or potassium) cyanide	Up to saturation	150	Soft or hard	General
Sodium (or potassium) hypochlorite	Up to saturation	150	Soft	Specific
			Hard	General
Sodium (or potassium) sulphide	Up to saturation	150	Soft or hard	General
Sodium (or potassium) sulphite	Up to saturation	150	Soft or hard	General
Sodium (or potassium) thiosulphate	Up to saturation	150	Soft or hard	General
Silver nitrate	Up to saturation	150	Soft	Specific*
Tin chloride (either stannous or stannic)	Any aqueous solution	150	Hard	General
			Soft or hard	General
Zinc chloride	Up to saturation	150	Soft or hard	General
Zinc sulphate	Up to saturation	150	Soft or hard	General
3. Organic Materials				
Acetic acid	Any concentration	150	Hard	Specific
Acetic anhydride	.....	150	Hard	Specific
Acetone	Any concentration	150	Soft	Specific
			Hard	General
Amyl alcohol	Any concentration	150	Soft	Specific
			Hard	General
Aniline hydrochloride	Any concentration	150	Soft or hard	General
Butyl alcohol	Any concentration	150	Soft	Specific
			Hard	General
Casein	Any concentration	150	Soft or hard	General
Castor oil	.....	150	Hard	Specific
Citric acid	Up to saturation	150	Soft	Specific
Coconut oil	.....	150	Hard	Specific
Cottonseed oil	.....	150	Hard	Specific
Dyestuffs	.....	150	Hard	Specific
Ethyl alcohol	Any concentration	150	Soft	Specific
			Hard	General
Ethylene glycol	Any concentration	150	Soft or hard	General
Formaldehyde (formalin)	40 per cent aqueous solution	100	Hard	Specific
Formic acid	Any concentration	100	Hard	Specific
Furfural	.....	100	Hard	Specific
Gallic acid	Up to saturation	150	Soft or hard	General
Glucose	Any concentration	150	Soft or hard	General
Glue	Any concentration	150	Soft or hard	General
Glycerine	Any concentration	150	Soft or hard	General
Lactic acid	Any concentration	150	Hard	Specific
Malic acid	Up to saturation	150	Soft or hard	Specific
Methyl alcohol	Any concentration	150	Soft	Specific
			Hard	General
Mineral oils	.....	100	Hard	Specific
Propyl alcohol	Any concentration	150	Soft	Specific
			Hard	General
Soaps	Any concentration	150	Soft or hard	General
Tannic acid	Up to saturation	150	Soft or hard	General
Tartaric acid	Up to saturation	150	Soft	Specific
			Hard	General
Triethanolamine	Any concentration	150	Soft or hard	General
Vinegar	.....	150	Hard	Specific

*If discoloration is to be avoided.

ble hard rubber compounds. In general, it can be stated that hard rubber is superior to soft in its resistance to these materials.

Another serious limitation upon the use of rubber in chemical service is temperature. Above 150 deg. F., the effects of oxidation, diffusion, and absorption become aggravated; and the useful life of rubber products is materially shortened under such conditions, despite all that can be done through intelligent compounding to resist these effects.

Great strides have lately been made in compounding rubber to resist the action of oils, greases, fats, and organic solvents as well as the deteriorating effects of high temperature service (up to 250 deg. F.). It must be candidly recognized, however, that these are serious causes of deterioration even with the best of modern compounds and that the successful use of rubber in such service depends rather upon unique physical properties of the material and the lack of better materials than upon inertness to the factors of limitation.

In discussing limitations, it is of interest to note that distilled water affects rubber more seriously, especially at elevated temperatures, than do most of the solutions enumerated above. This apparently is due to molecular diffusion and is, therefore, markedly retarded by the presence of electrolytes.

When pure water swells soft rubber, dissolved oxygen carried into the rubber undoubtedly plays an important part in the resultant deterioration. The same is true of the rapid deterioration encountered when rubber is swollen by oils. In both cases, hard rubber is found to resist diffusion, absorption, and swelling incomparably better than soft.

Considering for the moment only the two basic materials common to all vulcanized rubber compounds, sulphur and rubber, it is a well-established fact that the resistance to chemical and solvent action, to the effects of oxidizing agents, to diffusion of gases and vapors, and to absorption of liquids is increased as more sulphur is combined in vulcanization. In vulcanizing to the hard-rubber stage, moreover, we obtain greater rigidity, adaptation to certain mechanical processes such as machining, drilling, and sawing, and electrical properties not available in any other known material. At the same time are sacrificed much of the elasticity, resilience, and resistance to abrasion of soft vulcanized rubber.

The coefficient of linear expansion of true hard rubber within the temperature range 32 to 140 deg. F. is from three to five times that of steel, a fact which sometimes renders hazardous the use of large-size steel equipment lined with hard rubber for service where rapid changes in temperature are encountered. Hard rubber at temperatures below 32 deg. F. becomes quite brittle, with consequent danger of cracking or breakage if subjected to shock.

Recognizing certain distinct advantages and certain limitations in each type of rubber, soft and hard, for chemical service under conditions of variation in temperature, liability of shock, impact or gouging, and abrasive wear, technologists have produced a practical construction which successfully combines the two types. In this construction, a layer of hard rubber is cushioned between two layers of soft rubber, with suitably spaced overlapping expansion joints which effectively prevent cracking or buckling of the hard layer under expansion and contraction with temperature changes.

This combination can be bonded to steel and certain other constructional materials and finds its chief application in lining tanks and other process equipment in chemical and allied industries. For a detailed description of this development the reader is referred to *Chem. & Met.*, Vol. **38,** page 396.

▼ ▼ ▼

Wood Products in Britain

By MAURICE SCHOFIELD

Wolverhampton, England

A SURVEY of present tendencies in wood distillation should start with charcoal, for this commodity was the primary aim of wood carbonization centuries ago. For some months the market price has remained at around $25 per ton according to grade and locality, this high figure indicating that charcoal must bear a good share of working costs. But the demand is small, for metallurgy seems to favor the forest-burned product. Charcoal is therefore offered as a chemical rather than a fuel, and its powder is being promoted as a grassland clearing agent.

Acetic acid is quoted in the market only as the 40 per cent form; for great as are the demands for concentrated acid, imports from Shawinigan, the home synthetic product, and the products from oxidation of ethanol at the Hull works of British Industrial Solvents, Ltd., can supply all needs. Acetates and iron liquor are in fair demand for the textile industries, where the tariff is creating a boom. Wood spirit as a denaturant and methyl alcohol for manufacture of formaldehyde are in fair demand.

But the British distiller puts his greatest hopes in two liquid products: methyl acetone and wood tar with its oil fractions. Demands for the former are brisk, the greatest consumption being as solvents and diluents in the nitrocellulose, cellulose acetate, and gums and resins industries. The 40-50 per cent product is commanding about $180 per ton, although it is faced with competition from European supplies. Composition of the cheaper forms varies from 25 to 35 per cent methyl acetate and 39 to 42 per cent acetone, the rest being wood spirit. These solvents are also offered in standard grades at low prices and being water- and acid-free, of water-white color and definite boiling range, are in high favor.

Every possible use for wood-tar distillates is being explored. Although the oils have been so successful in exterminating certain beetles, the general use of wood creosotes for wood preservation is hindered by the low prices prevailing for coal-tar creosote. Other insect pests and scales in poultry houses also have succumbed to application of wood tar.

Greater developments are expected when suitable methods of treating tar distillates have been improved. The lightest oils distilling below 100 deg. C. have good solvent powers; but the intolerable odor—when the original tar was from mixed hardwoods—has hindered progress in this direction. The three types of tar available in the country are: mixed hardwood tar, wood-gas producer tar, and birchwood tar. Oils from the latter are different in odor and in absence of high boiling fractions.

Laminated Glass Production Brings Technical Refinements

EDITORIAL STAFF

WHEN, two years ago, the technical status of the laminated glass industry was surveyed for *Chem. & Met.* by James F. Walsh (**37**, 7, p. 418, 1930), there were still a dozen companies actively engaged in this assemblage of two other industrial products, pyroxylin plastic and plate glass. In a few cases the laminated glass producer was also the maker of the glass; more often he was wholly a "middleman," contributing the specialized laminating technique to the product. In spite of a complex patent situation and a general air of mystery, the technique was fairly uniform everywhere and had a rather primitive aspect compared with other chemical and mechanical operations.

This unstable business structure has meanwhile been thoroughly shaken down by a combination of its own weakness and the economic recession, especially in automobile production. Surviving are a few large companies, producers of plate glass, with background and resources for methodical research work. One of them, the Duplate Corp., now wholly owned by the Pittsburgh Plate Glass Co., is the subject of description here. Its plant is located in a new 5-story brick building at Creighton, Pa.

Preparation of Materials

Because the largest consumer of laminated glass is the automobile maker, the constituent materials are procured in shapes approximating windshields and windows. Patterns and templets of various standard types are kept in stock for any desirable or necessary recutting.

The pyroxylin plastic usually is supplied in rectangular sheets, which are thoroughly inspected in a dark room with walls painted black. The individual sheets are scanned against both the black background and over a white table illuminated with mercury vapor lamps. This inspection is for the purpose of eliminating haze, smudge, dirt spots and other objects in the plastic, which when laminated into safety glass, might tend to produce distorted vision. Great advances have been made in the quality of plastic supplied, and rejections have been reduced to a minimum.

After this inspection, the sheets are ready for use. They are cut to shape around templets of steel or glass, by means of a surface scratch made with a sharp steel scriber, which permits a clean break at the mark. This operation, like most others, is accompanied by a further inspection, necessitated by the exigent requirements of the ultimate product. In normal practice, the cuttings, which are sold as scrap, usually amount to only 2–3 per cent of the original pyroxylin plastic supplied.

The plate-glass requirements of this plant are filled by the adjoining factory of the Pittsburgh Plate Glass Co., which manufactures a special grade of $\frac{7}{8}$-in. plate glass especially for the Duplate Corp. It is conveyed to the cutting room on cars through a connecting tunnel and subjected to rigid examination before delivery.

Assembling Glass and Plastic Sheets

The laminating technology, where the glass and plastic converge, is conducted on a separate floor below the operations just described. Its two essential steps consist of a long cleaning and assembly line, and a final hydraulic-pressure treatment. It represents a modification of the older technique with its empirical methods and high proportion of rejects.

In two types of laminated glass, called Duolite and Aerolite, window glass is used. This also is supplied by the Pittsburgh Plate Glass Co., from its window glass factories at Clarksburg, W. Va.; Mount Vernon, Ohio; and Henryetta, Okla. Aerolite is produced almost exclusively for aeroplane and airship use or where weight is a paramount factor, and is fabricated from extremely thin window glass, called photo-glass. Duolite is fabricated from either single-strength or double-strength window glass, as required by the customer.

In any case, the glass is cut exactly to templet, as described for the plastic, and is again subjected to a rigid examination.

The conveying line, running at about 11 ft. a minute, consists of parallel sets of shorter belts composed of different materials at different points. The glass sheets are transferred from trucks to the belts and, to insure faultless adhesion later, covered with a cleaning mixture of pumice and water. The pumice dries in passing under a blast of heated air, and is then removed by a set of four successive brushes, operating with a suction. At this point the line enters a separately housed compartment, ventilated with filtered air.

After a final wiping with silk, the glass feeds onto a short wooden-roll conveyor where it is sprayed with an adhesive gelatinous solution. The spray is emitted from

a large pendulous arm with multiple nozzles, swinging transversely to the conveyor at a sufficient number of strokes per minute to deposit a uniform film of adhesive over the glass. Excess adhesive sprayed onto the rolls is removed by a bath through which the roll conveyor passes and which also receives any excess spray missing both the rolls and the glass. From the spray chamber, the glass passes through an electric heater, where the adhesive is dried.

At this point, the pyroxylin sheets are introduced to the production line, after passing through a rotating-brush washing machine, for a final cleaning and drying. They are then laid between the coated sides of two glass

plates and carried on wooden rod conveyors out of the inclosure to the preliminary pressing.

Joining the Sheets

A troublesome feature of the industry has always been a uniform and flawless sealing of the laminating sheets. The traditional platen press must be delicately adjusted, consumes much time, and usually squeezes the sheets thinner at the edges, extruding some of the plastic. The Duplate Corp. has found it more expedient to give a brief preliminary edge-sealing press, and then to complete the seal hydraulically.

In the partial sealing, the sheets are transferred by hand from the conveyor to a hot press, where they are inclosed in rubber blankets, the space evacuated, and the rubber-wrapped sandwich subjected to air pressure. The important objective is to obtain good adhesion near the edges and total exclusion of air inside. After this brief operation, the sheets are returned to the conveyors, and eventually are stacked in a special truck.

These trucks consist essentially of a carriage mounted with a removable circular wooden rack carrying two tiers of sheets conveniently but separately mounted. After being wheeled to the autoclaves, the racks are lifted from the carriage by a crane and charged into the pressure chamber in superimposed pairs. In the autoclave, a two-story cylindrical chamber, the laminated glass is subjected to a heavy hydraulic pressure at elevated temperature and for varying periods of time, according to the type of product being fabricated. At the end of the cycle, it is completely and uniformly bonded over its entire area. A slight solvent action on the edge of the pyroxylin plastic is encountered, because an organic liquid with suitable physical properties is used. But the resultant recession in the plastic is advantageous later.

On removal, the rack is sprayed with warm water, but the quantity of organic liquid washed away has not justified a recovery system. After cooling, the laminated glass is conveyed to the finishing operations on the floors below.

Finishing the Bonded Glass

One of the most extensive departments of any glass plant is the grinding room. In the Duplate Corp., a whole floor is devoted to standard emery and sandstone wheels, and polishing equipment. A special feature of interest is an edge treatment in which the sheets are stacked on lead strips and dipped into a tank of concentrated H_2SO_4, which dissolves the plastic about $\frac{1}{8}$ in. deeper than the glass edge. This furrow is later filled up with cold pitch from a rotating felt wheel, which leaves the laminated glass securely sealed against deterioration from exposure. The product is now marketable, and after suitable boxing and packaging is shipped to the consumers, principally automobile, bus, aeroplane, and safety appliance manufacturers.

For the consideration shown in its visit to this plant, *Chem. & Met.* is especially grateful to J. H. Sherts, superintendent, and E. L. Fix, of the technical staff.

Preliminary Sealing, at Left, Before Charging Into Autoclave for Hydraulic Seal, as Below

Nickel-Clad Steel Plate For Equipment

By ERLE G. HILL

Industrial Fellow
Mellon Institute of Industrial Research
Pittsburgh, Pa.

DESPITE the fact that the corrosion-resistant properties of nickel have long been known, only a year ago first announcement was made of a material that offered the advantages of the protective properties of nickel and the strength and weight of steel plate. At that time (*Min. & Metall.*, February, 1931, p. 90) the new composite metal, Nickel Clad, was described.

The interest aroused and the excellent results obtained by fabricators since then have created a demand for plates in a wide range of size and gage. With the aid of an industrial fellowship of Mellon Institute and the staff of the Lukens Steel Co., the production has now been so improved that plates can be furnished varying from 12-gage to extra heavy weights. Plates as large as 330x96 in. are now being made, and the manufacture of larger ones is being planned.

Formerly on all plates the nickel surface was covered with a brown nickel oxide, which was formed during the open rolling at high temperatures. The surface finish was similar to that found on standard steel plates. This type of plate is still being manufactured and is extensively used, as the oxide itself has excellent resistant properties. In recent months, however, a new Nickel Clad has been evolved whose face is free from oxide, with a bright finish and surface superior to that produced by standard plate-mill practice.

Nickel-Clad plates are made of mild steel and malleable nickel. Usually the steel constitutes 90 per cent of the thickness and the nickel 10 per cent. Owing to the solubility of iron and nickel and the similar properties of steel and nickel at rolling temperatures, the process of manufacture in use effects a perfect bond between the two metals. The zone of fusion between the nickel and steel can be distinctly detected, and shows that the nickel is actually an integral part of the plate.

The nature of this bond between the component metals of the plate enables the fabricator to employ the methods usually followed in fabricating equipment from steel plates. Such cold-working operations as shearing, punching, bending, flanging, and forming are carried on in the customary manner, while hot-working includes spinning, flanging, and die-pressing. In pressing and flanging, the nickel may be formed on either the inside or the outside of the formed part. Another feature of importance to the engineer is the excellent thermal conductivity of the plate. As there is no break at the junction of the two component metals, there is no interruption to the flow of heat by surface transference. This fact makes the use of Nickel-Clad plate practical in equipment where heat transference is of importance.

Experience has demonstrated, however, that there are a few precautions that must be taken in its fabrication into equipment. The application usually makes it imperative that only a continuous nickel surface be exposed to the corroding medium. Otherwise an iron-nickel couple will be set up and rapid deterioration will occur. In riveting, solid nickel rivets or rivets protected by nickel should be employed. Welding is performed with nickel rods. In hot-working, the serious nature of the effect of sulphur on nickel should be remembered. If the sulphur content of the gases is high, the nickel is attacked along the grain boundaries and loses its ductility. This action of sulphur was one of the difficulties that had to be overcome in the manufacture of large-size plates. Low sulphur content fuels (not over 0.5 per cent) should always be used in heating to prevent damage to the material.

The following summary of the physical properties of Nickel-Clad steel contains the data that are of utility in engineering design (the figures relate to plate made from 0.20 carbon steel clad with 10 per cent malleable nickel):

Gage	Yield Point, lb./sq.in.	Tensile Strength, lb./sq.in.	Elongation per cent in 8 in.	Reduction in Area, per cent
0.502 in.	40,200	60,800	30.5	59.0
0.636 in.	40,300	61,300	30.0	64.6

In Nickel-Clad steel plate the engineer has available a useful and economical material for the fabrication of heavy equipment in which the employment of nickel is most desirable, but was formerly barred because of the high cost of nickel. Consequently the new composite metal is proving to be of value in a large number of industrial fields.

Equipment Constructed of Nickel-Clad Steel

▼

Pressure and Reaction Rate

In the article on the Potrerillos sulphuric acid plant, by E. L. Larison, in the February issue, a statement was condensed to read: "This conclusion is substantiated by comparing the reaction rates at Anaconda, Mont., 5300 ft. above sea level, and at Potrerillos, 9500 ft., which would be as 760^2: 531^2." This, of course, is incorrect; the ratio applies to plants at Potrerillos and *sea-level*, whereas the pressure at Anaconda is somewhere between the two. The point, however, was that lower pressures would impair the economy of the reaction, all else being equal.

Metallization of Wood Opens New Uses

By M. NAPHTALI
Berlin-Wilmersdorf
Germany

ALTHOUGH a technology for the impregnation of wood by such liquids as creosote and zinc chloride solution has long been developed, it is only recently that higher melting compounds, among them sulphur and metals, have been exploited for the same purpose. Metallized wood was first reported in *Chem. & Met.* in June, 1930, Vol. **37,** No. 6, p. 390. The work mentioned there was carried on by Hermann M. Schmidt at the Kaiser Wilhelm Institut für Eisenforschung, and has since been turned over to practice. The product achieved by Schmidt is a wood whose original structure is permeated with such low-melting metals as lead, tin, or alloys.

In principle, the process makes it possible to open the microscopic pores of the wood and, through them, to fill the individual cells with molten metal, while retaining the original form of the cells. Because of the latter fact, the finished product consists of a wooden structure each of whose cells has an isolated charge of metal.

The technology of the process is confined to a preliminary treatment of the wood, principally drying, after which it is immersed in molten metal and then exposed to a moderate pressure in a closed vessel. The process is readily controlled, so that the wood can be impregnated to its very interior. The size of the treated pieces is limited only by the size of the apparatus and the economic time limit of the treatment, which differs according to the purpose. Wooden blocks 16x4x2 in. in size are completely impregnated in a few seconds. If desirable, the metallization can be so controlled that only the cross-section of the wood is filled with metal, or that only the surfaces are impregnated to a greater or less extent, while the inner zone remains untreated.

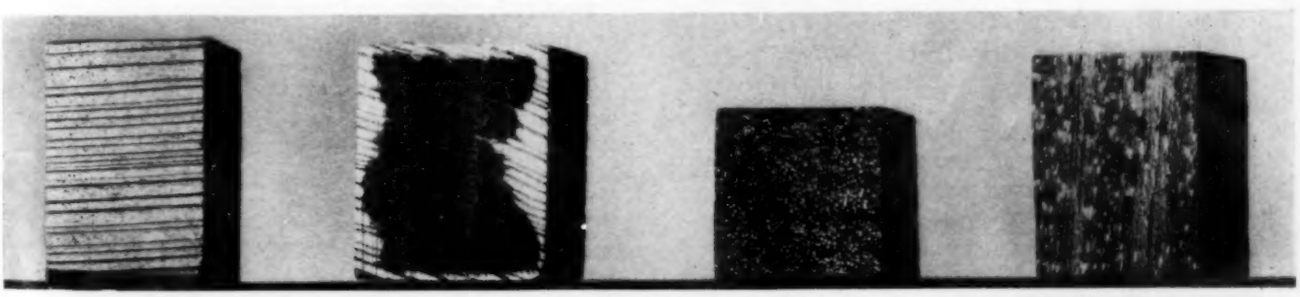
The properties of the new material depend to some extent on the types of wood and metals chosen for impregnation. Offhand, the most conspicuous property is the increase in weight; for example, walnut treated with tin goes as high as 3.83 in specific gravity, more than half of tin (7.28). In the case of pine, a specific gravity of 4.83 was reached, equivalent to two-thirds by volume of metal. It was not found that the tensile strength of wood is much affected either way. The hardness and compression strength, however, were notably improved in proportion to the metal content. In general they become two or three times the value for wood alone; in the case of antimony-lead alloys, considerably higher values are obtained. Apparently the mechanism of the compression resistance is that the wooden structure prevents any creep or flow of metal while being supported itself by the metal.

The material shows up to special advantage in exposure to moisture or fire. Swelling in moist atmospheres or in water is greatly reduced and even entirely prevented if the wood is strongly metallized. Walnut which previously absorbed 87 grams per 100 c.c. in 24 hours in water at 80 deg. C., absorbed only 4.4 grams per 100 c.c. after metallization. Of trial strips immersed in moist soil or salt water, the pure wood was warped and split, whereas the metallized wood showed no change. The metal, of course, rapidly dissipates any heat to which the material may be exposed; nor are any combustible gases formed. After prolonged intense heating, when the metal has flowed from the surface, the wood will begin to glow like charcoal, but it does not otherwise support combustion.

Electrical conductance depends on the direction of application, as does the heat conductance. In the direction of the grain, a heavily metallized piece conducts very well, but transversely it is an insulator to practically the same degree as wood. Typical heat conductance ratios, across and with the grain, of plain and metallized wood were found to be 1:2 and 1:10 respectively.

The workability of the material is much like that of wood. It can be planed, drilled, sawed, and so on. Hence it has already been applied experimentally to various industrial purposes, such as exterior structure, in corrosive atmospheres, and for decorative purposes. However, a commercial use that has already found wide application is in bearings for various machinery, such as rolling mills.

In the latter instance, the property of the metallized wood of absorbing 3 per cent by volume of oil under pressure, combined with its own hardness, obviates the necessity of lubricating and of using certain expensive woods that are frequently employed. In Germany such bearings are being prepared by the Oellos G.m.b.H. Dortmund. An advantage of the metallized wood was found to be the rapid heat transfer by the metals away from the bearing surface, which eliminated the danger of overheating and expelling the lubricant. This bearing has been applied principally on high-speed machines with light bearings, idlers, inaccessible bearings, and machines where the products might be contaminated by lubricants. Other applications of this principle—e.g., with creosote oil for marine uses—immediately suggest themselves.



Cross and Longitudinal Sections of Metallized Samples: Heavily Impregnated on Right; Lightly Loaded on Left

Designing Foundations for Self-Supporting Towers

By C. O. SANDSTROM

Thermal Engineering Co.
Los Angeles, Calif.

PLACING absorption or fractionating towers on foundations of sufficient mass to insure stability against wind pressure has the decided advantages of good appearance and freedom from obstructive guy lines and their anchorages. In some cases the cost of such a foundation compares favorably with that of the guyed tower. A few guyed structures that have come to my notice contained enough concrete in the foundation and in the guy anchorages to provide foundations for two self-supporting towers.

A curious psychological factor is involved in the popular attitude toward towers and chimneys. A slight sway of a self-supporting tower gives a sensation of insecurity, while the guyed tower may positively reel without causing alarm—the visible evidence of restraint offered by the guys being, of course, the soothing factor. Analogous cases are steel structures or frames designed by novices. The members are large enough to satisfy the eye, while the connections may be capable of developing only a small fraction of the strength of the members.

In the design of foundations for absorption towers, and the like, we have the choice of a number of shapes, circular and polygonal. The circle has the advantage of simplicity of design, but the formwork presents some difficulties of construction. The shape of the foundation selected, however, should approach the circular, for in this form the resisting moment on all axes is constant.

In Figs. 1 to 4 are practicable shapes of foundations. The simplicity of the square of Fig. 1 has sometimes led to its adoption in ignorance of the fact that the critical axis is along the diagonal, *b–b*, and its resisting moment only 70 per cent of that normal to the axis, *a–a*. Accompanying the several figures are analyses of their properties. They have been made comparative by assuming a common area of 100 sq.ft.

A brief explanation of the factors involved in the stability of foundations is desirable at this point. What is known as the section modulus, S, about any neutral axis such as *a–a* or *b–b*, is the quotient of the moment inertia about that axis divided by the perpendicular distance from the axis to the most distant point of the figure. In Fig. 1, for instance, the moment of inertia about *a–a* is $D^4/12$ and S is $D^4/12 \div D/2 = D^3/6$. About *b–b*, the moment of inertia is $D^4/12$ and S is $D^4/12 \div \sqrt{2}D/2 = 0.118D^3$. The section modulus may be obtained similarly for the other figures.

This quantity, S, has the units of cubic feet, and the property, when divided by the area of the figure, A, of giving a third factor, x, which is the resisting moment-arm of the figure. This factor represents the distance from the center of the figure to the point where the resultant of the dead load and the wind load intersects the base of the foundation. As long as the resultant falls within the radius, x, there is no uplift of the edge of the foundation on the windward side. It is obvious, therefore, that the most suitable shape for a foundation is the one which yields the largest minimum value of x, since in this case, the least dead load is required to resist the wind pressure and prevent overturning. Comparisons of the minimum values of x for the foundation shapes of Figs. 1 to 4 show that the octagon is 22.5 per cent better than the square, 12 per cent better than the hexagon, and 2.8 per cent better than the circle.

To illustrate the method of design of a foundation for a self-supporting tower we shall select a tower of 48-in. diameter and 50-ft. height, as shown in Fig. 5. The assumed wind pressure is 20 lb. per square foot on a flat surface, which, on the cylindrical tower, reduces to two-thirds of this, or 13.33 lb. The weight of the empty tower is 30,000 lb. We shall assume that the tower may sometime be full of liquid which imposes a so-called "live load" of 30,000 lb. We must also assume the height of the center of gravity of the projected area of the tower from the bottom of the foundation (which is the wind moment-arm), and the width of the foundation. While the distance from the center of the tower to the bottom of the foundation may be decided at the outset, the choice of the width of the foundation may require two or three trial calculations in order to correlate the weight, the width, and the thickness of the bottom course of concrete.

As a first step, choose what appears to be a suitable foundation size and shape and determine, first, the wind moment, then the weight of foundation, as follows:

Take wind pressure as 20 lb. per square foot on flat surface

$P = 4 \times 50 \times 20 \times 0.667 = 2{,}667$ lb. total wind pressure on projected area. To care for the area of piping, call this a flat 3,000 lb.

Then M_w, the wind moment, $= 3{,}000 \times 28 = 84{,}000$ ft.-lb.

Assume top course of foundation to be a 6-ft. octagon, and bottom course to be a 10.75-ft. octagon.

Then, area of top course, A_t, equals $6^2 \times 0.828 = 29.8$ sq.ft.

And, area of bottom course, A_b, equals $10.75^2 \times 0.828 = 95.7$ sq.ft.

According to Fig. 3, $S = 10.75^3 \times 0.109 = 135.5$ ft.^{3}

Hence, $x = 135.5/95.7 = 1.416$ ft.

Therefore, required total weight of empty tower and foundation to prevent overturning at assumed wind pressure is

$84{,}000/1.416 = 59{,}320$ lb. But the weight of the empty tower is given as 30,000 lb. Hence, the weight of foundation required is $59{,}320 - 30{,}000 = 29{,}320$ lb.

Of this required weight of concrete, the top course will account for $29.8 \times 2 \times 145 = 8{,}640$ lb., leaving $29{,}320 - 8{,}640 = 20{,}680$ lb. to be accounted for by the bottom course of concrete.

Therefore, the required thickness of the bottom course is determined to be $20{,}680/(95.7 \times 145) = 1.49$ ft., or call it 18 in.

In most cases the maximum soil pressure, which exists under the combined action of a tower full of liquid and the maximum wind pressure, is well within the bearing capacity of soils usually encountered.

Beneath the tower of Fig. 5 is shown a load diagram which gives the intensities of the live-load, dead-load, and wind-load pressures. The live load per square foot equals $30{,}000 \div 95.7 = 314$ lb.; the dead load, $59{,}320 \div 95.7 = 620$ lb.; and the wind load, $80{,}000 \div 135.5 = 620$ lb. The total of the three loads, 1,554 lb., is, as stated, well within the capacity of most soils. The wind-load diagram is a triangle whose area is that of the dead-load diagram because the required dead load was determined by use of the wind load. The effect is that of converting the area of the dead-load rectangle into a triangle, thereby doubling the intensity of pressure on the leeward side of the foundation.

The detail in Fig. 5 shows a means of securing the tower to the foundation. A conical plate is welded to the bottom head of the tower, which makes the joint between the shell and the head accessible for inspection, as well as for calking should leaks develop. The lower portion of the cone is welded to a ship channel that is rolled to the required diameter. The bolts pass up through the flanges of the channel, the whole being extremely rigid. The conical plate may be replaced by a number of steel tees that would give the base the appearance of a spoked wheel.

There have been a number of methods proposed for arriving at the size of anchor bolts for the kind of work under discussion. One method assumes an area under compression and equates the resisting moment of the bolts to the compression moment thus found. The objection to this method is the assumption. Another considers the base as similar to a circular concrete beam, finds the position of the neutral axis, and determines the number and size of bolts in the manner of reinforcing rods. Another assumes the bolts as consolidated into a thin, circular sheet of steel of the diameter of the bolt circle and obtains the sectional area by dividing the bending moment by the section modulus and the working stress, then dividing this area by the number of bolts to obtain the area of a single bolt. In other words, solve for a hollow cylindrical beam.

Still another method, and the one used here, is to determine the distance, x, as was done for the foundation; that is, divide the section modulus of the base ring by its area. We then deduct the moment of stability of the tower from the wind moment and proportion the bolts for the remaining moment. As an example of this, use the data of Fig. 5 as follows:

Taking the total wind pressure, as before, as 3,000 lb. and the wind moment-arm about the base ring as 24.5 ft., the wind moment is $3{,}000 \times 24.5 \times 12 = 882{,}000$ in.-lb.

Section modulus of a ring is $\frac{\pi}{32}\left(\frac{D^4 - d^4}{D}\right)$ hence, S for the base ring is $\frac{0.098(63^4 - 56^4)}{63} = 9{,}200$ in.^{3}

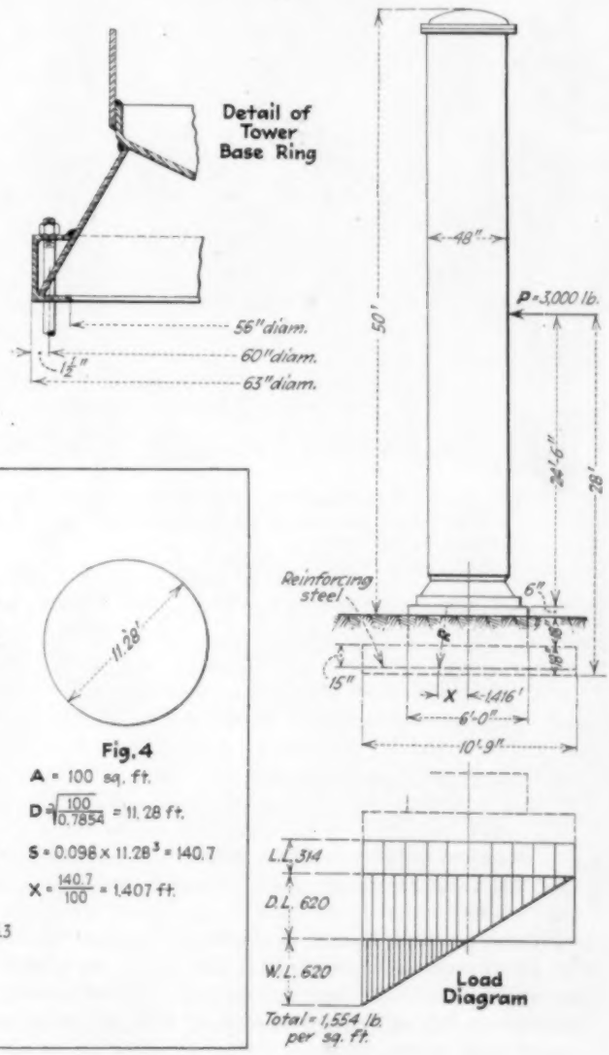
Area of the base ring is $(63^2 - 56^2)\ 0.7854 = 654$ sq.in.

Hence $x = 9{,}200/654 = 14$ in. and the resisting moment of the empty tower is $30{,}000 \times 14 = 420{,}000$ in.-lb.

Therefore, the moment to be taken by the tower bolts is $882{,}000 - 420{,}000 = 462{,}000$ in.-lb. which is to be distributed to eight bolts.

To avoid possibility of overstressing bolts through injudicious tightening of the nuts, assume a comparatively low working stress, 8,000 lb. per square inch for the case

Fig. 5—Self-Supporting Tower for Which Foundation Weight, Load Diagram, and Reinforcing Steel Are Calculated in the Text



Figs. 1-4—Suitable Foundation Shapes Giving for Each Form, on the Basis of Equal Areas, the Section Modulus and Resisting Moment-Arm About Extreme Neutral Axes

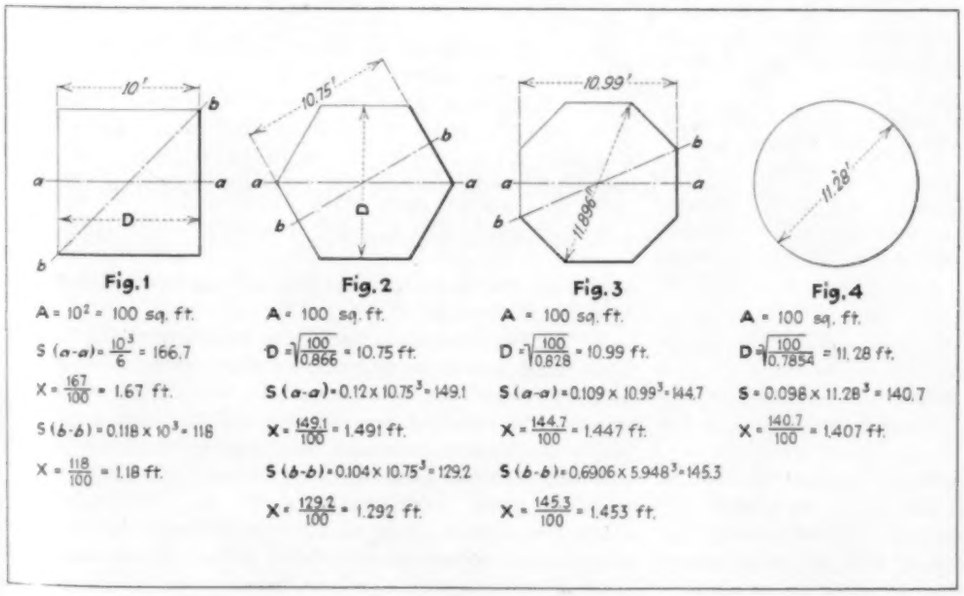


Fig. 1

$A = 10^2 = 100$ sq. ft.

$S\ (a\text{-}a) = \frac{10^3}{6} = 166.7$

$X = \frac{167}{100} = 1.67$ ft.

$S\ (b\text{-}b) = 0.118 \times 10^3 = 118$

$X = \frac{118}{100} = 1.18$ ft.

Fig. 2

$A = 100$ sq. ft.

$D = \sqrt{\frac{100}{0.866}} = 10.75$ ft.

$S\ (a\text{-}a) = 0.12 \times 10.75^3 = 149.1$

$X = \frac{149.1}{100} = 1.491$ ft.

$S\ (b\text{-}b) = 0.104 \times 10.75^3 = 129.2$

$X = \frac{129.2}{100} = 1.292$ ft.

Fig. 3

$A = 100$ sq. ft.

$D = \sqrt{\frac{100}{0.828}} = 10.99$ ft.

$S\ (a\text{-}a) = 0.109 \times 10.99^3 = 144.7$

$X = \frac{144.7}{100} = 1.447$ ft.

$S\ (b\text{-}b) = 0.6906 \times 5.948^3 = 145.3$

$X = \frac{145.3}{100} = 1.453$ ft.

Fig. 4

$A = 100$ sq. ft.

$D = \sqrt{\frac{100}{0.7854}} = 11.28$ ft.

$S = 0.098 \times 11.28^3 = 140.7$

$X = \frac{140.7}{100} = 1.407$ ft.

in hand. Then, the area at the root of the thread of a single bolt applied at the center of the tower— that is, with a moment-arm of 14 in.—is $462{,}000/(14 \times 8{,}000) = 4.13$ sq.in. With eight bolts located adjacent to the angles of the octagon foundation, the area of each is $4.13/8 = 0.52$ sq.in. The nearest commercial bolt size is 1 in., which is to be used.

It is not necessary to consider the bearing pressure in the foregoing calculations, for even if there were no base ring used—that is, if the edge of the plate were in contact with the concrete foundation—the pressure would not be excessive.

In the foregoing design of the foundation, no allowance was made for the effect of the soil on the projection of the footing. The weight of this soil could be deducted from the required weight of the concrete, thereby effecting a considerable economy. When this is not done, the weight of the soil provides additional security. Another factor adding to security, but one that cannot be evaluated with any degree of accuracy, is the frictional resistance of the concrete against the soil. In fact, the foundation could be made narrow and deep and advantage taken of the lateral resistance of the soil in the manner of a fence-post. Such a foundation would be more economical than the one figured, but, as it is a departure from precedent, the proposal probably would meet with considerable objection in some quarters; not logical objection—just objection.

Nearly everyone knows that a hollow beam is stronger than a solid one of the same sectional area. The effect is obtained by distributing the material at a greater distance from the neutral axis, thereby increasing the section modulus. The layman's impression is, however, that the mere removal of the material from the center strengthens the remainder, which, of course, is a fallacy.

In the case of the kind of foundation discussed in the foregoing, the removal of material from the center, thereby decreasing the section modulus, actually increases the resistance to overturning. In the example illustrated by Fig. 5, it was shown that the maximum soil pressure was small compared with foundation pressures generally. By removing material from the center we increase the unit pressure on the remainder of the foundation and consequently the resistance to overturning. We shall demonstrate this fact by an example, using the data of Fig. 5, with the removal of a 4-ft. core from the foundation.

Top course, 6-ft. octagon	$A_t = 6^2 \times 0.828 = 29.8$ sq.ft.
Core, 4-ft. octagon	$A_c = 4^2 \times 0.828 = 13.25$ sq.ft.
Net area of top course	16.55 sq.ft.
Bottom course, 10.75-ft. octagon	$A_b = 10.75^2 \times 0.828 = 95.7$ sq.ft.
Net area bottom course	$= 95.7 - 13.25 = 82.45$ sq.ft.

$$S = \frac{0.11\ (10.75^4 - 4^4)}{10.75} = 134 \text{ ft.}^3$$

$$x = 134/82.45 = 1.63 \text{ ft.}$$

Required total weight $= 84{,}000/1.63 =$	51,500 lb.
Weight of empty tower	30,000 lb.
Required weight of concrete	21,500 lb.
Weight of top course, $16.55 \times 2 \times 145 =$	4,800 lb.
Required weight of bottom course	16,700 lb.

Thickness of bottom course $= 16{,}700/(82.45 \times 145) = 1.4$ ft.

By the method shown in the load diagram of Fig. 5, the maximum soil pressure is found to be slightly in excess of 1,600 lb. per square foot. And coring the foundation has effected a saving of 2 cu.yd. of concrete —decidedly worth while.

Extended concrete footings as shown in Fig. 5 must be reinforced with steel to resist the bending caused by the pressure of the soil. The first example above (Fig. 5) disclosed a maximum pressure of 1,554 lb. per square foot at the edge of the foundation. The maximum bending moment, for which steel reinforcement is required, is in the vertical plane of the edge of the top course of concrete. The load to be considered is that on the area of the projection of the footing or bottom course. By an inspection of the load diagram of Fig. 5 we find that the pressure due to the wind load reduces inward from the edge of the foundation. The reduction is small, however, and can be ignored or, as in the present case, can be partly allowed for by using the round figure of 1,500 lb. per square foot as the load.

The length of the projection, or cantilever, is $(10.75 - 6)/2 = 2.375$ ft. The diameter of its median line is $\sqrt{\frac{95.7 - 29.8}{0.828}} = 8.92$ ft. The total pressure on the projection is $(95.7 - 29.8) \times 1.500 = 98{,}850$ lb. The distance of the median line from the side of the top course of the foundation is $(8.92 - 6)/2 = 1.46$ ft., or 17.5 in., which is the arm of the bending moment. Had the distance to the middle of the projection been used we would have had only 16.25 in. The bending moment, therefore, is $98{,}850 \times 17.5 = 1{,}730{,}000$ in.-lb. We shall take as the width of the beam the periphery of the 6-ft. octagonal top, which is $0.414 \times 6 \times 8 = 19.9$ ft.

With a maximum stress of 600 lb. per square inch in the concrete and 16,000 lb. per square inch in the steel, the distance from the centroid of the compression area of the concrete to the steel—that is, the resisting moment-arm—is $0.88 \times 15 = 13.2$ in., where 0.88 is a constant known as "*j*" in concrete calculations, and 15 is the depth in inches of the steel beneath the top of the footing. Then the area of the steel is $\frac{1{,}730{,}000}{16{,}000 \times 13.2} = 8.2$ sq.in. Dividing the area of the steel by the width of the beam we have $\frac{8.2}{19.9} = 0.412$ sq.in. per foot of width. The nearest commercial size bar is $\frac{3}{4}$ in. square, which could be used, but better still are $\frac{1}{2}$-in. square bars on 7-in. centers.

It is not necessary to carry the bars clear across the footing. The length of the bars on each side of the plane of the maximum bending-moment need be only 40 diameters in order to develop the bond strength, in this case 20 in. With the outer ends about 3 in. from the edge of the footing the required length of the bars is 43 in. and the number is $\frac{8.2}{0.25} = 32.8$—say four to each side. If the bars are carried all the way across the footing, 16 bars 10 ft. long will do.

It has been noticed that some self-supporting towers sway slightly for a short time after erection and that after a while the sway ceases. This phenomenon is due to the consolidation of the soil by settlement. A slight settlement increases the bearing capacity of the soil very much. If a building, instead of being erected piece by piece, were placed on the soil in a completed state, the settlement in a short time would be so great as to cause embarrassment from failure of the sidewalk properly to meet the ground floor.

Recovering Volatile Solvent in a Cellulose Acetate Process

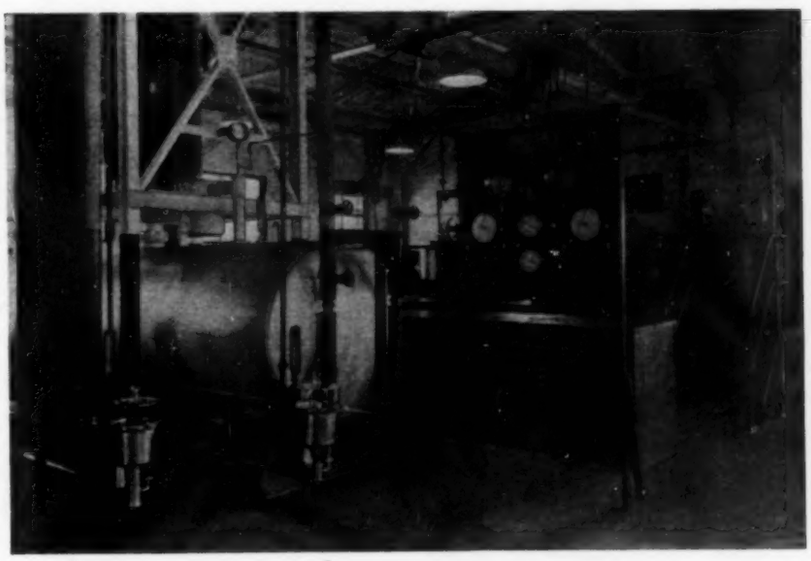
Activated carbon absorbers effect a recovery of more than 85 per cent of the acetone used as a solvent. Thorough precautions have been taken to prevent fire and explosion and to render them harmless if they should occur

By C. R. AVERY and H. KRESS

Western Electric Co.
Kearny, N. J.

IN THE telephone plant of the Bell system a large quantity of textile-insulated wire is used for wiring the switchboards and connecting them to the incoming cables. The constant demand for better electrical characteristics in the telephone circuits has led the engineers to seek an improved insulation for this wire. This has resulted in the application of a thin film of cellulose acetate to the textile insulation, substantially improving the wire.

The method developed consists of passing the textile insulated wire through an acetone solution of cellulose acetate. A low-viscosity solution is used to produce a thin coating and involves large quantities of the acetone solvent. This makes it economical to recover the solvent after it has been driven off from the coated wire.



Distillation Equipment for the Dehydrating of Acetone, on Left; Solution Tanks, on Right

It was determined that the procedure should include several passes of the wire through the cellulose acetate solution with the excess of solution removed by wiping dies and the coating dried after each pass. The first coating machines developed used electrical heating elements as a source of drying heat. The newest type machine utilizes steam. A rapid circulation of air quickens the rate of drying, and with a sufficiently long drying chamber, a high rate of wire travel is possible.

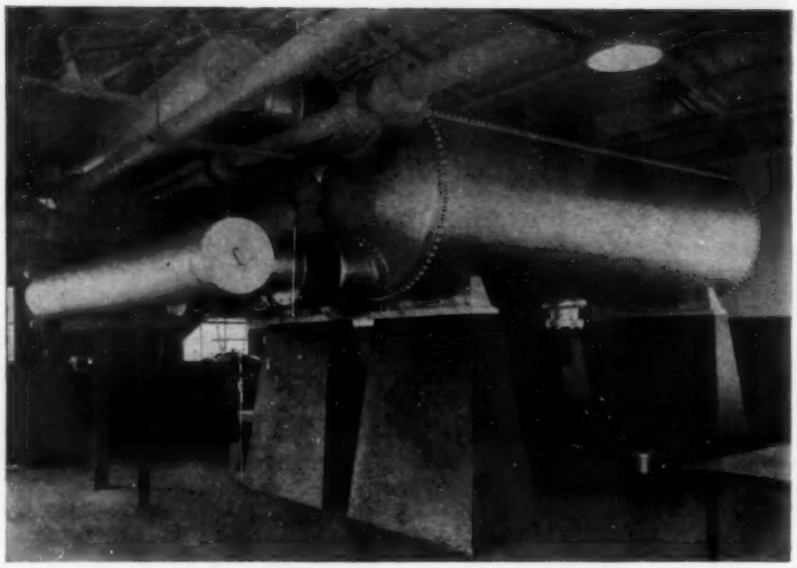
In planning a commercial installation it was necessary to go into the problems of preparing and circulating the cellulose acetate solution, recovering the acetone, and making the entire process as safe as possible from the hazards that are always present when using a solvent such as acetone.

Two buildings instead of one are used to separate the large quantities of solution present in the mixing room from the room in which the coating machines with their electrical equipment are located. The acetone is pumped from the underground storage tanks to the mixers. The cellulose acetate is weighed out from bins and placed in the mixers and the whole stirred for several hours until fully dissolved. The solution is then pumped continuously from the mixers to the machines. From the machines it flows to a sump by gravity and from the sump is forced back to the mixers. The reasons for circulating the cellulose acetate solution are to keep it homogeneous, to keep the quantity of solution in or near the machines as small as possible, and to permit control and maintenance of its viscosity at one location instead of in the individual dope pots.

It was found that the viscosity of the solution had to be maintained within close limits, as the weight of film left on the wire changes with the viscosity. To indicate

continuously the viscosity, a constant quantity of solution is pumped through an orifice and the back pressure developed is measured by a pressure gage calibrated for viscosity. Deviations from the required viscosity are corrected by the addition of acetone or a more concentrated solution that is kept in readiness.

To keep the quantity of solvent low for the required viscosity, the temperature of the solution is kept at about 86 deg. F. Although a higher temperature would require the use of even less solvent, it would increase the loss by evaporation. The desired temperature is maintained by a water coil installed in the mixer, the water in turn being heated by steam. The mixers are equipped with standard propeller-type agitators driven through gear reduction by totally inclosed motors.



Charcoal Absorbers for the Recovery of Acetone From the Treating Machine Air Exhaust

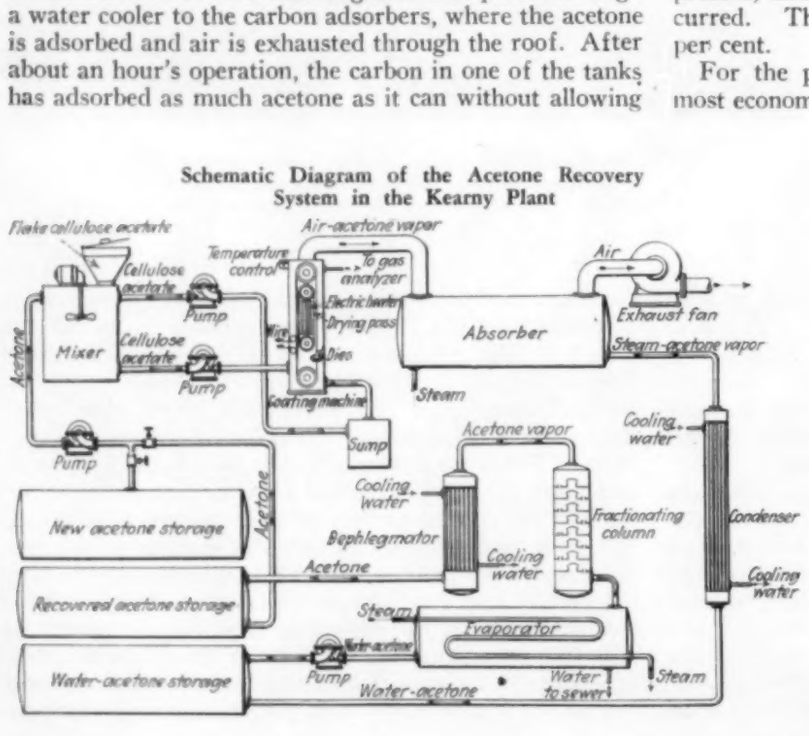
During the drying operation the acetone is evaporated, giving a mixture of air and acetone vapor within the drying chambers. This mixture would be explosive if the concentration of acetone vapor were allowed to get between approximately 2.5 per cent and 13 per cent by volume, and at the concentration of 5 per cent an explosive force of as high as 75 lb. per square inch might result. To eliminate the possibility of a vapor explosion, enough of the mixture is constantly drawn away through an exhaust duct so that the concentration of acetone will not exceed 1.5 per cent. The vapors are conducted back to the building in which the mixing was performed and the acetone is recovered.

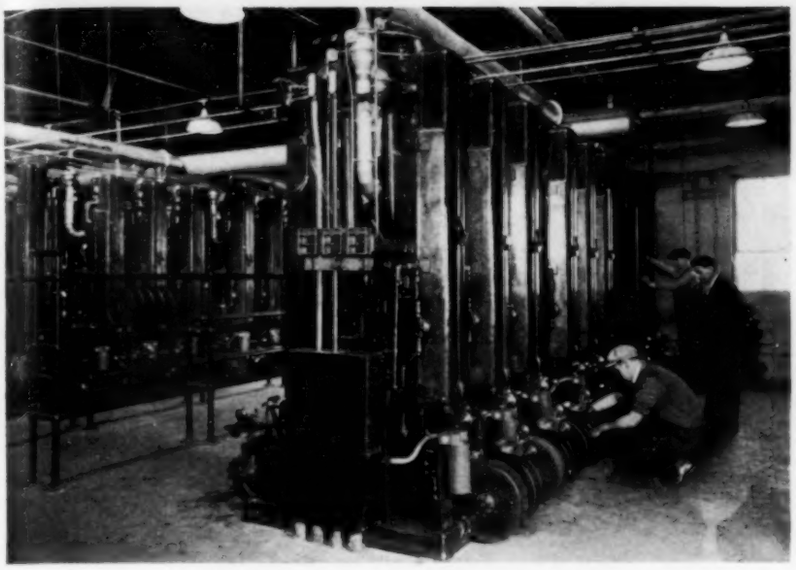
The acetone recovery system consists of activated carbon adsorbers, a condensing tower, and a dehydrating plant. The air and acetone mixture coming through the exhaust header from the coating machines passes through a water cooler to the carbon adsorbers, where the acetone is adsorbed and air is exhausted through the roof. After about an hour's operation, the carbon in one of the tanks has adsorbed as much acetone as it can without allowing a portion of it to pass through, and the air valves are switched to pass the acetone-air mixture through the other adsorber. Steam at low pressure is then admitted to the first adsorber and the acetone is driven off. The steam and acetone vapors are condensed, giving a condensate that averages about half water and half acetone. This flows by gravity to one of the outside underground storage tanks, where it is held until it can be dehydrated. When a supply of water-acetone has accumulated, it is pumped to the evaporator and the dehydrating is performed in the usual way. The recovered acetone flows by gravity to another of the underground tanks for reuse. Samples are taken at intervals to insure that the dehydration is complete, that no foreign materials are present, and that no breakdown of the solvent has occurred. The over-all recovery of acetone is 85-86 per cent.

For the purpose the carbon adsorption process was most economical. Scrubbing with water or other adsorbing mediums would not give so high a percentage of recovery and would be more expensive to install and operate. Freezing out the acetone would not be so economical with the low concentration of acetone-air mixture that must be maintained to afford safety from explosion.

Throughout the engineering of this installation, the greatest precautions were taken against possible fire and explosion. Double 40-mesh screens were placed close to the junction of the vent pipes with the underground tanks. The mixing tanks were equipped with explosion relief openings covered with .002-in. aluminum sheet. The tanks were vented to the recovery system. Attached to the mixing tank is a carbon-dioxide fire-extinguishing system. One outlet is within the tank and another one is

Schematic Diagram of the Acetone Recovery System in the Kearny Plant





Machines for Treating Textile Insulated Wire With Cellulose Acetate

above the explosion relief opening. This carbon-dioxide system will be released automatically if a quick rise in temperature occurs within the mixer and it can also be operated through a hand-pull box on the outside of the building. Operation of the carbon-dioxide system in the mixers or in any other place in the plant causes all electric power in both buildings to be turned off instantly, sounds a siren, and calls the fire department. To avoid the possibility of static sparks while loading the flake cellulose acetate into the mixer, a humid atmosphere is obtained by injecting steam.

In the coating machines themselves, precautions have been taken both to prevent fires and to render them harmless if they should occur. A temperature well above 1,000 deg. F. is required to ignite acetone, and the electric heating elements are operated at about half this temperature. The temperature of the drying chamber is controlled by a pyrometer which turns on or shuts off the electric heating current as required. As a further safeguard, a second temperature control, set at a slightly higher temperature, is arranged to act if the first one fails, shutting off the current and sounding a gong. Here again a carbon-dioxide fire-extinguishing system is permanently attached, with an outlet in each drying chamber. Automatic discharge would be difficult to control because of the temperature conditions in the chamber; therefore the carbon-dioxide is controlled entirely from hand-pull boxes. Hand CO_2 equipment also is available in convenient locations. Explosion vents covered with aluminum foil are located in the rear of each unit.

However, as previously mentioned, there is no danger of explosion of the acetone-air mixture in the drying chamber if the percentage of acetone is maintained at less than the quantity that will propagate flame—about 2.5 per cent. Acetone-air analysis instruments of a standard make are permanently installed, taking readings from each of the drying chambers and from various points in the exhaust lines. These instruments operate on the basis of difference between the thermal conductivities of air and of atmospheres containing various amounts of acetone vapor. Two platinum coils, heated by a constant electric current, form two arms of a wheatstone bridge. Around one of these coils is room atmosphere, containing whatever moisture and other impurities it may, while around the other coil are the gases drawn from the drying chamber, cooled down to the same temperature, containing acetone vapors in addition to the constituents of the room atmosphere. The different thermal conductivities of the gases around the two coils cause a difference in temperature followed by a change in resistance of the platinum coils, resulting in a reading on the galvanometer. The instrument is calibrated to read directly in per cent acetone. If a reading greater than the allowed maximum of 1.8 per cent concentration is encountered, a gong is sounded and the head is immediately switched to half speed until the trouble is located and remedied. Should the acetone concentration reach 2.2. per cent the coating equipment is automatically stopped. The percentage of acetone concentration can be varied by increasing or decreasing the quantity of room air drawn through the machine to the recovery system.

To avoid all sparks in the operating rooms, where some acetone vapor may exist, a separate control room with entry from the outside only is provided. Lead-covered cables running through sealed ducts connect the machines with the control room and all fuses and relays are in this room. Switches on the machines are oil-immersed or fully inclosed and gas-tight. A magnesite floor is provided to prevent the striking of sparks from reels or tools that may be dropped and brass floor plates are used instead of steel for the same reason.

▼

Injury Rates

The National Safety Council is authority for valuable data concerning the accident injury rates in the chemical industries during 1931. Chemical plants reporting 1931 accident experience had an average frequency rate of 12.65 and a severity rate of 1.84. These compare with 20.62 and 1.52 for the paper and pulp industry; 15.86 and 1.01 for food companies; and 10.87 and 2.22 for steel plants. Reports in the chemical industry came from 238 plants, a gain of 27 over 1930, and the largest number ever reported. These organizations worked almost 182,000,000 man-hours and had 2,300 lost-time injuries. The total time lost was almost 1,000 years. There were 166 serious injuries, including 36 fatalities. The average time lost from a temporary disability was 17 days.

Chemical plants as a group must face the fact that no consistent progress has been made during the last two years in the reduction of serious injuries. Improvement has been confined entirely to temporary disabilities, with the result that the total severity rate has gone considerably higher. The increase in severity in 1931 was due principally to more fatalities.

EDITORIAL STAFF REPORT

Electrochemical Developments Discussed at Baltimore

THE annual meeting of the Electrochemical Society attracted nearly 200 members to Baltimore, April 21-23. Among the notables present were seven of the society's past presidents: Lawrence Addicks, Charles F. Burgess, Colin G. Fink, Francis C. Frary, Walter S. Landis, F. A. Lidbury, and S. C. Lind. The round-table discussion of fertilizer; and the papers on the so-called rare metals, tellurium, selenium and beryllium; and copper refining, for which this Maryland city is so well known, accounted for much of the unusually large attendance.

Lawrence Addicks presided at the opening session after Herbert A. Wagner, president of the Consolidated Gas, Electric Light & Power Co. of Baltimore, formally greeted the visitors. The main discussion centered about the new highly efficient Nichols-Herreshoff roaster for copper anode slimes; the recent developments in oxygen-free copper; and, in particular, selenium and tellurium, the old stepchildren of the copper industry.

It was a great surprise to many in the audience to hear of the recent prominence and development of these two metalloids in the chemical and metallurgical industries. S. Skowronski and M. A. Mosher, of the Raritan Copper Co., after briefly describing the improved methods of recovery of Se and Te from the anode slimes, emphasized that the consumption of the former in the United States had increased almost sixfold within the last ten years and that of the latter fivefold within the last five years.

The chief use for selenium today is in the glass industry where it is employed both as a decolorizer and in the manufacture of ruby glass. During the World War, the embargo on the use of high-grade manganese dioxide for the decolorizing of glass led the glass manufacturers to substitute selenium, and the large quantity of the metal used for this purpose accounts for the rapid increase in its sales. The ceramic industry uses selenium in conjunction with cadmium sulphide to obtain various red and orange shades of enamel. Of late years selenium has been used with success in rubber compounding, since it increases the resistance of the rubber to abrasion by 50 to 80 per cent. Wire cable sheathed with selenium rubber is on the market and is advertised as such. Selenium also acts as a flame-proofing material in cable. And some selenium is now used in the dye industry for the manufacture of special dyes.

With the development of television, selenium cells have been improved considerably, and the lack of uniformity and high inertia of the earlier types of cells have been corrected. Several makes of selenium cells are on the market today that are guaranteed to give satisfactory service.

According to G. D. Bengough and L. Whitby, a process has been developed for the production of a thin film of selenium on several light magnesium alloys. This film imparts considerable resistance to the corrosive action of sea water. The film is normally produced by immersion for a few minutes in a bath containing selenious acid.

As to tellurium, U. C. Tainton, in the discussion of the paper, announced the startling discovery that the element is a most valuable reagent for purification of zinc solutions at Western zinc plants. Almost 90 per cent of the United States output of Te was used for this purpose in 1930. There are three impurities in electrolytic zinc solutions that are particularly objectionable: Sb, Ni, and Co. In their presence, even in minute quantities, a poor desposit of zinc or none at all, is produced. Upon the addition of metallic zinc to these solutions cobalt will be thrown down —but only in the presence of Te; in its absence the cobalt remains undisturbed. The Te required is about 13 lb. per ton of zinc.

The discussion of the papers proved to be a source of interesting information. U. C. Tainton announced the startling discovery that tellurium is a most valuable reagent for purification of zinc solutions at Western plants. Both tellurium and selenium have become prominent in chemical and metallurgical industries. According to P. H. Brace, of the Westinghouse company, properly prepared beryllium, contrary to popular opinion, is comparatively soft and ductile. And Andrew V. Re, of Coldwater, Mich., reported that he has plated hundreds of thousands of aluminum articles with nickel or nickel-chromium by first applying a plate of brass.

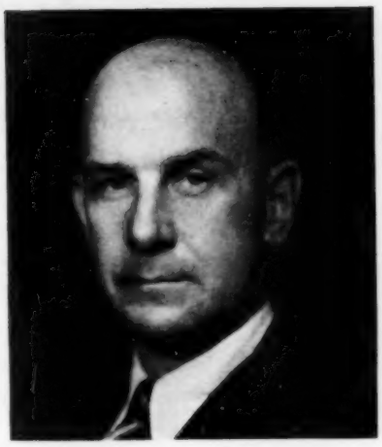
Edwin W. Rouse, manager of the Baltimore copper works, felt that the United States output of both metalloids could be appreciably increased if the demand justified it. He paid grateful homage to the late Dr. Victor Lenher, who had contributed so largely to the chemistry of selenium. Correcting the statement of one of the audience that the selenium cell had outlived its usefulness and been the audience that the selenium cell Dr. C. F. Burgess, of battery fame, stated that the new selenium cells are far superior to the old classical type and that because of their high efficiency they were being used in "talkie" apparatus in England and France. A bright future for the new selenium cells seem assured. Their lag is comparatively small.

Frank F. Colcord, of the U. S. Lead Refinery, Inc., stated that little if any Se and Te is derived from sulphuric-acid manufacture. Practically all comes from the copper and lead smelters and refineries.

Prof. Alexander Silverman, of the University of Pittsburgh, presented a résumé of his researches and those of others on the use of Se and Te in glass making. Investigations on Te indicate color-producing tendencies like those of selenium. However, no commercial applications have as yet been made, although further investigations may render these possible.

F. A. Lidbury, president of the Oldbury Electrochemical Co., conducted a lively round-table discussion in his usual inimitable manner. Dr. Walter S. Landis, vice-president of the American Cyanamid Co., gave a clear and striking exposition of the present status of the fertilizer industry. There are three processes for phosphoric acid competing with one another: the thermal, the electrochemical, and the chemical. Our present production capacity is about double our consumption; however, it is safe to figure on an annual increase of about 10 to 15 per cent in consumption. J. A. Barr, chief engineer of the International Agricultural Co., discussed the relative merits of the blast furnace method vs. the electric furnace method. Dr. Colin G. Fink read a letter received from the manager of the new phosphate plant in the Pyrenees, one of the largest electric furnace plants in the world. He also referred to the addition of small quantities of copper to fertilizers for timothy and clover pastures to insure the proper and essential quantity of this metal in the cow's milk. Dr. Henry Arnstein, of Philadelphia, reported that, after all, the most important fertilizer is CO_2 and that all other substances such as potash, nitrate and phosphate are of only secondary importance. He referred briefly to a number of tests made to show this. Others participating in the round-table discussion included T. F. Baily, of Alliance, Ohio; and W. N. Gambrill, of the Davison Chemical Co.

Friday afternoon was devoted to the electric furnace and its products. The opening address was delivered by Dr. John A. Mathews, vice-president of the Crucible Steel Co. and metallurgist of world-wide renown. It was the occasion of initiating the Joseph W. Richards memorial lectures. In introducing Dr. Mathews the chair, Bradley Stoughton, paid a high tribute to the memory of Dr. Richards, first president and for many years secretary of the Electrochemical Society. The title of Dr. Mathews' memorial address was "The Electric Furnace and the Alloy Age." It was a most interesting account of the epoch-making investigations and discoveries of Frederick W. Taylor, Hadfield and others, resulting in our present highly specialized alloy steel industry. Without the aid of the electric furnace the rapid progress would have been impossible, and no one has contributed so lavishly to the art as Dr. Mathews himself.



Duncan MacRae, Chairman of the Entertainment Committee

Dr. John A. Mathews, the First Richards Memorial Lecturer

One of the many highlights of this interesting address was the announcement of the correction of carbide precipitation on reheating in so-called austenitic steels. This action causes the metals to become less resistant to corrosion and particularly susceptible to intergranular corrosion by the action of various electrolytes. This has been serious in connection with welded structures.

In recent investigations carried on at the Crucible company's research laboratory, Payson discovered that among the austenitic steels those which possessed the highest resistance to intergranular attack were the ones which consisted, in addition to austenite, of a small portion of the delta phase, whose presence was induced by the addition of certain elements, such as silicon, molybdenum, vanadium, and so forth.

Dr. Mathews stated that it is not possible to say that a steel is or is not subject to intergranular corrosion without defining the conditions under which it is to be tested. The electrolyte in contact with the steel is the determining factor.

Then followed the presidential address by Prof. Stoughton, of Lehigh University, on the electric furnace and its products, emphasizing in particular the recent developments in the electric production of pig iron from ore. Edwin L. Crosby and his associates, A. E. Rhoads and Carl H. Morken of the Detroit Electric Furnace Co., reported on the successful invasion of the rocking indirect arc furnace into the iron and steel foundry—a furnace that had heretofore confined itself almost exclusively to the non-ferrous alloys. W. E. Moore, of the Pittsburgh Electric Furnace Corp., submitted the latest data on his four-voltage arc furnace. Among the products cited was gray iron for high-pressure pipe work, high-temperature castings, and long-wearing castings. D. L. Ogden, of the U. S. Metals Refining Co., praised the Northrup induction furnace, and E. F. Russ, of Cologne, cited applications of his induction furnace.

R. R. Ridgway and A. H. Ballard, of the Norton Co.,

described at length their painstaking temperature investigations of the large resistor furnaces used in making silicon carbide. The pyrometer readings for the central core ranged between 1,850 and 1,950 deg. C., whereas the maximum temperatures attained in any part of the furnace are 2,550 to 2,600 deg. C., which lie above the decomposition point of the carbide (graphite being produced). Silicon carbide heated in air lasted for a long time at temperatures below 1,100 deg. C. A lively discussion followed, in which E. C. Sprague, of the Acheson Graphite Co.; Dr. E. F. Northrup, of Princeton, N. J.; W. A. Koehler, of Baltimore; M. E. Fogle, of Columbia; Frank W. Brooke, of Pittsburgh, and E. G. Nutting, of the Carborundum Co., Niagara Falls, participated. Much of the contention centered about the proper mode of determining the high temperatures dealt with in the silicon carbide furnace.

Beryllium Metal and Alloys

Joseph Rossman, patent examiner at Washington, reported that the U. S. Patent Office had established a new class, No. 13—Electric Furnaces, and that over 2,000 patents were already assigned to this class. He described at length the 36 subdivisions of the class. Rossman was plied with dozens of questions—which would seem to indicate that class No. 13 was a popular one. At all events there is little doubt that a number of outstanding improvements have been made within recent years in the design and operation of electric furnaces.

Dr. Alfred Stock, of Karlsruhe, Germany, at present visiting professor at Cornell, submitted an interesting account of the Siemens and Halske process of making beryllium metal and alloys commercially at $80 to $300 per pound of Be. Of immediate practical application are the beryllium-bronzes, which are about as resistant to corrosion as the tin or the aluminum bronzes. They likewise cast easily, are readily cold worked, and can also be hardened by a suitable heat treatment. When 2 to 3 per cent Be is added to copper, the hardness is increased to five times the original (from 100 up to 400 or 500 brinell); the limit of ductility is increased sevenfold, the breaking and the bending limits three-fold. A copper alloy with 6 to 7 per cent Be has a brinell hardness of 750, corresponding to that of the hardest steel.

Dr. Stock emphasized that the metal beryllium is very brittle and is so hard that it scratches glass. After the fused electrolyte experts present at the meeting were all agreed that this brittleness and hardness is one of the stumbling blocks in the further development of the metal, P. H. Brace, of the Westinghouse research laboratories, announced that if the metal were properly prepared it was comparatively soft and ductile.

The concluding paper of the furnace session was entitled "The Electron Theory and Magnetism," by Prof. F. W. Constant, of Duke University. It was one of the most interesting papers of the convention.

Prof. D. H. Andrews, of Johns Hopkins, inaugurated the all-day Saturday session with his interesting experimental lecture on dynamical models or organic molecules. His illustrations and deductions were most convincing and contribute much to the better understanding of the behavior of various compounds under different conditions of temperature, radiation, and so on.

F. M. Brigham and Hiram S. Lukens, of the University of Pennsylvania, investigated the electrolytic reduction of nitrobenzene to para-aminophenol. Nitrobenzene in suspension in sulphuric acid may be reduced to para-aminophenol with a material yield of 65 per cent and a current yield of 62 per cent of the theoretical by observing the following conditions: the use of a two compartment cell; catholyte—50 per cent sulphuric acid; ratio of nitrobenzene to catholyte, 1.25:4; agitation of catholyte sufficient to keep nitrobenzene in uniform suspension; current density just below that which causes evolution of hydrogen gas (3.4 amp./sq.dm.); temperature, 25 to 60 deg. C.; nickel cathode. The paper drew forth pointed questions from both theorists and manufacturers. B. H. Jacobson, of E. C. Klipstein & Sons Co., discussed the methods of determining the yield of para-aminophenol and emphasized the importance of obtaining a snow-white product. Prof. Sherlock Swann, Jr., of the University of Illinois, felt that the cathode overvoltage factor was an important one. Prof. Alexander Lowy advocated the use of nickel-gauze cathodes, in reply to which Prof. Lukens stated that the cathode used was a perforated one.

Guy H. White, Jr., and Lowy then described their experiments on the electrolytic oxidation of leuco-bases of the triphenylmethane series of dyestuffs and exhibited a series of attractive green dyes together with samples of dyed goods.

The leuco-bases of four triphenylmethane dyes were oxidized electrolytically by two different procedures. By the first, leuco-bases which are insoluble in water and alkalis were oxidized as solid depolarizers in carbon and leuco-base mixtures. It was shown that the depolarizer must be in direct contact with the electrode where electrochemical action takes place and that a high concentration of solid organic depolarizer can be incorporated with carbon to form a conducting anode mixture. The second method deals with leuco-bases which are soluble in alkalis. The authors stated that these leuco-bases can be oxidized in a solution of sodium carbonate when used as soluble depolarizers in the usual way.

Plating Nickel on Aluminum

Next followed a group of six papers on plating submitted by members of the industry and university laboratories. The deposition of ternary alloys is an accomplished fact. Of special interest was the announcement by A. V. Re, of Coldwater, Mich., that he had plated thousands of aluminum articles successfully with an adherent coat of nickel, or nickel and chromium, by first applying a plate of brass onto the carefully cleaned aluminum surface.

At the afternoon session a dozen miscellaneous papers were presented and discussed, Prof. Lukens presided and led the discussion. Among the topics brought up were the quinhydrone electrode, the physical chemistry of flotation, corrosion of iron and nickel alloys, osmosis, and crystal and electrolytic rectifiers.

The social entertainments were well planned and unusually attractive. There were visits to industrial plants and a number of group suppers. President Stoughton made an able chairman and Duncan MacRae and W. C. Moore, of the local committee, spared no effort in looking after the many details of the lengthy program.

During the business session, election of the following officers was announced: president, R. A. Witherspoon, of the Shawinigan Chemicals, Ltd., Montreal; vice-presidents, Duncan MacRae, E. M. Baker, and Sterling Temple; managers, Acheson Smith, O. P. Watts, and W. S. Landis; treasurer, R. M. Burns; and secretary, Colin G. Fink.

Welding Engineers Focus Interest on Ductility

DURING the three days, April 27 to 29, 1932, the American Welding Society held its annual convention in New York City, and engaged in the presentation of more than 20 papers, including a group on several phases of ductility in welds, which was an outstanding feature. New officers elected included Frank P. McKibben, consulting engineer, president; and A. E. Gaynor, John A. Roebling's Sons Co., senior vice-president of the society.

It is impossible to review here more than a small number of the fourteen papers not included in the ductility symposium. E. R. Hensel and E. I. Larsen, Westinghouse Electric & Manufacturing Co., reported on a study of the transformation points of fusion weld metal. These investigators found that the transformation points of samples were lowered with increasing nitrogen content. Strong hydrogen annealing of various samples produced temperature-expansion characteristics in all cases quite similar to those obtained with pure iron.

In recent years increasing importance has attached to the matter of intergranular corrosion in austenitic steels. John A. Mathews, Crucible Steel Co. of America, explained at length the cause and cure of such corrosion. He showed that reheating such steels to temperatures ranging from 1,000 to 1,500 deg. F. produces the greatest susceptibility of austenitic steels to intergranular corrosion. The explanation of this action seems to be that carbides at the grain boundaries are thrown out of solid solution, reprecipitating as such at the boundaries.

There are three methods for reducing the danger of intergranular corrosion. The first is to use a steel with the lowest possible carbon content. Another method is to heat-treat the entire part after welding at a temperature of 1,800 deg. F. or above. This treatment has the further advantage of relieving stresses in the structure. The third method involves the addition to the steel of elements which tend to inhibit the intergranular action. Suitable elements include titanium, silicon, vanadium, molybdenum, and tungsten.

Wrought Iron Fusion Welds Satisfactory

James Aston, A. M. Byers Co., discussed briefly the history of wrought iron, pointing particularly to its suitability for plastic welding. Recent experience, he said, has indicated that fusion welds may also be made in this material with entire satisfaction. In general it should be worked hotter than other ferrous metals. A puddle of molten metal should always be maintained at the point where the rod is being applied, the end of the rod being kept immersed in this molten puddle until enough metal has been deposited. With reasonable care during welding, impurities can easily be floated to the surface, aided by the fluxing effect of the wrought-iron slag.

The symposium on weld ductility was of such length as to require an entire session. In the majority of these papers, the authors were in agreement in believing in the necessity of ductility in weld metal. Prof. C. A. Adams, of Harvard University, confined his remarks to the less debatable phases of the subject, expressing the belief that fewer opinions and more facts were needed. He pointed out that ductility undoubtedly plays an important part in vessels pierced by openings, although he stated it as his opinion that for many types of structure, high ductility is not essential. He explained the desirability of ductility by showing how the ability of the metal to stretch results in readjustment and reduction of the original stresses in certain regions where, if the material were brittle, a crack might result and produce failure.

Everett Chapman, of Lukenweld, Inc., summarized the requirements of good welds, stating the need for high strength, high yield points, high fatigue limits, and clean steel. E. R. Fish, Hartford Steam Boiler Inspection & Insurance Co., discussed the importance of ductility in welded pressure vessels, stating the principle that weld metal should have physical characteristics which closely approach those of the base metal. Ductility, as he declared, permits the redistribution of stresses and safeguards the integrity of the structure.

On the other side of the question, C. J. Holslag, Electric Arc Welding & Cutting Co., deplored the publicity value of "ductility," declaring that ductility in the weld greater than that of the parent metal would ruin welding. Fortunately, he remarked, such ductility cannot be attained. He agreed that a certain amount of ductility—say, up to 20 per cent—is desirable in eliminating welding strains.

C. H. Jennings, Westinghouse Electric & Manufacturing Co., discussed the measurement of weld ductility and expressed a belief that the most satisfactory method is by elongation and reduction of area. The ductility of butt welds, he stated, may be obtained either from tensile tests or bend tests. There are, however, no apparent relations between the ductilities as measured by these two methods.

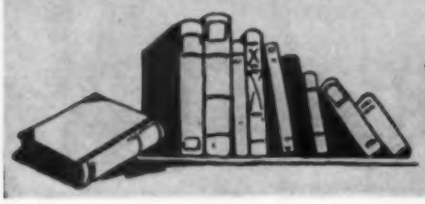
"Crackless Plasticity" Desirable

The significance of, and testing for, ductility were subjects treated by Prof. H. F. Moore, University of Illinois. He discussed a characteristic of metal which he termed "crackless plasticity," defining this as ability to withstand repeated stresses without the spreading of cracks originating in minute defects. Metals differ widely in their cracking tendency, but fine-grained metals seem to be especially susceptible. Ordinary ductility, he declared, may be regarded as insurance against fracture under occasional overloads, and crackless plasticity, against the formation, under repetitions of normal loads, of a spreading crack from some source of highly localized stress.

It was the conclusion of Prof. D. Rosenthal, University of Brussels, Belgium, that a certain amount of ductility in welded joints is much to be desired in order to prevent overstressing. He stated as his criterion that ductility should be as high as possible in both the weld and parent metals. Even for fatigue resistance, a certain amount of ductility proves to be beneficial for welded connections.

Two of the symposium papers were of a less general nature than those discussed above. T. N. Greene, Linde Air Products Co., discussed weld ductility requirements for welded pressure piping, concluding that ductility of 10 to 12 per cent seems sufficient to meet all service requirements of pressure piping. C. L. Waddell, Worthington Pump & Machinery Corp., reported on an engineering and economic study of arc welding. Ductility, he declared, is desirable, although it cannot compensate for poor design. One of the findings of his investigation was that welds could be produced with coated rods at little increase over the cost of using bare rods.

Chemical Engineer's Bookshelf



Rogers' Manual

MANUAL OF INDUSTRIAL CHEMISTRY. Fifth Edition. Edited by *Allen Rogers*. D. Van Nostrand Co., New York City. Two Volumes, 1,517 pages. Price, $13.

A NEW EDITION of Rogers is always something of an event, not alone because of the magnitude of the work but because it brings the record up to date and because there is always a consistent and noteworthy improvement in each new issue. Since the fourth edition in 1925, American chemical technology has taken sizable strides, albeit its seven-league boots are now at the shoemaker's for extensive repairs. It is pleasant to find that the new Rogers, in the main, has kept pace and that the majority of chapters are thoroughly modern in content. There appear to be a few exceptions, but in these cases it is probable that a difference of opinion is admissible.

There is much evidence of the attempt that has been made to put the material on a present-day basis. Several chapters have been rewritten by new authors, new chapters have been added, several old ones have been deleted. In certain cases, what was a single chapter in the fourth has become two or more chapters in the fifth edition. A single chapter on brewing and malting, wine, and distilled liquors has been added to replace the three chapters which appeared in the third edition and were omitted in the fourth. Largely for its historical interest, this section has been revived, according to an editorial note which announces that this concession to popular demand is in no way intended as an incentive to home industry.

The two-volume treatment initiated in the fourth edition has been retained, a fortunate move in the light of a further increase in length of about 250 pages. Of the total, some 39 per cent is devoted to inorganic chemistry in the first volume. This volume also contains a new chapter on industrial instruments which is well done, although it may be questioned whether the 52 pages given to it is justified in a book of this type. The remainder of the space is given over to organic processes which form the content of Volume II. This division seems to be a reasonable one, although it appears proper to call attention to other less happy space allotments. Leather, for example, with its 87 pages, unduly overbalances synthetic ammonia with nine, mostly illustrations. Laundering, textiles, and dyestuffs and their application, three chapters totaling over 70 pages, seem overemphasized in the presence of a scant four pages for chemistry's own child, the synthetic fibers. Other instances of this sort can easily be cited, but to do so may obscure the outstanding fact that here is a book which fulfills its major objectives and which is a worthy addition to American chemical literature.

Patent Law in Chemistry

THE LAW OF PATENTS FOR CHEMISTS. By *Joseph Rossman*. Inventors Publishing Co., Washington, D. C. 304 pages. Price, $3.50.

Reviewed by D. B. KEYES

SEVERAL books published recently attempt to explain the rudiments of patent law to the chemist and chemical engineer. There is perhaps no book which fulfills this object better than the present one by Dr. Rossman. First of all, it argues convincingly that the chemist should be interested in patent law and explains the value of patents. The second part deals with essentials of patent law principles, including the answer to the question, When should a patent be applied for, remarks regarding the publication of results, and a description of the various kinds of chemical patents. Then follow chapters defining invention, novelty and utility.

The third part refers to the preliminary steps for obtaining the patent and includes the patent application's prosecution, interferences, etc. The fourth part deals with the rights under the patents, including the essentials of a valid patent, and the enforcement of patent rights. Part five covers miscellaneous information. This is followed by a glossary and various appendices. Under the appendices are included the illustrated official classes, some illustrated chemical patent applications. Patent Office statistics, and a table of parallel legal reports.

The author has paid considerable attention to the matter of claims, as claims are the essential or vital factors of the patent. The matter of claims cannot be overemphasized and the author would have done well to consider this matter in even greater detail. Construction and analysis of claims is something about which all chemists and chemical engineers working in a research or development field should have distinct and clear ideas. The chapter on the prosecution of patent application is particularly good. So is the chapter on patent rights.

Early in the book is given examples of certain very prominent chemical patents. The inclusion of the copy of the original patent file of Dr. Baekeland's famous invention of Bakelite is distinctly worth while. Another feature that can be highly recommended is the glossary. It is possible for the reader to look up any term with which he is unfamiliar and obtain a satisfactory definition. The book is unusually full of quotations from the literature, and special mention should be made of the excellent discussions by K. P. McElroy which have been utilized in various portions of the text.

This book is an excellent compilation of facts pertaining to chemical inventions. It can be heartily recommended not only to research and development workers in the industries but also to the students and staff of educational institutions.

Handbook of Analysis

CHEMISCHE - TECHNISCHE UNTERSUCHUNGSMETHODEN. By *Georg Lunge* and *Ernst Berl*. Eighth Edition. Vol. I. Julius Springer, Berlin. 1260 pages. Price, 98 M.

Reviewed by C. E. BETZ

THE FIRST VOLUME of this revised reference work begins with a rather elementary discussion of laboratory apparatus, equipment and layout, and general laboratory technique, including the principles of sampling and sample preparation. Following this is a section on qualitative analysis, both inorganic and organic, both being as complete as could well be expected in a work as all-inclusive

as this one attempts to be. A section on volumetric quantitative methods is followed by an excellent and complete discussion of the various applications of electrometric and potentiometric methods. Gas analysis is dealt with at considerable length. Short sections cover such subjects as colorimetry, and other optical methods, including applications of the refractometer, polarimeter, interferometer, photometer, spectroscope, etc. Metallography is discussed rather briefly, but there is an excellent and complete section on X-ray methods. A section on colloids, and lastly a good discussion of the methods of micro-chemical analysis complete the contents of this volume.

The work being almost encyclopedic in its scope, none of these sections perhaps will be sufficiently complete to satisfy the specialist, even though in some cases the minuteness of detail is almost painfully apparent. However, a very good presentation is given in turn of these important tools of modern research, and for the student seeking more complete or specific information on special subjects, excellent references are given in nearly all cases. All in all, the book unquestionably is a valuable addition to the reference shelf of any chemist or chemical library, although it is unfortunate that it is not available in the English language.

Gaseous Kinetics

THE KINETICS OF HOMOGENEOUS GAS REACTIONS. By *Louis Kassel*. The Chemical Catalog Co., Inc., New York City. 330 pages. Price, $6.50.

Reviewed by G. M. MURPHY

DURING the last few years, great progress has been made in both the theoretical and experimental study of homogeneous gas reactions. It is quite fitting that Dr. Kassel should write a monograph on this subject, for he has contributed so largely to its development.

The purpose of the book is best stated in the words of the author: "The primary purpose in writing this book was to provide, for the author's personal use, a summary of the present situation in the field of reaction rates; it is, of course, an essential duty of such a summary to point out those directions in which progress is most needed . . . Throughout the entire book a critical attitude has been adopted."

As these remarks might indicate, the first two chapters that introduce the theoretical part of the book are little more than a collection of formulas from statistical mechanics. The theory of bimolecular reactions is next treated, including the newer methods of London and of Eyring and Polanyi. Here again, the discussion is so brief that it can be of little use to one ignorant of the methods of quantum mechanics. Following this, trimolecular reactions and triple collisional problems are treated. The first part of the book is completed with a chapter on unimolecular reactions and collisional activations and finally one on complex reactions and various kinds of chains.

The experimental part of the book begins with a brief discussion of methods of testing the homogeneity and order of reactions, the question of temperature coefficients, methods of calculation, and the precision of reaction rate measurements. All of the experimental data available are then fully and critically discussed, following again the general plan of classification according to the order of the reaction involved. Remembering the warning about the critical attitude quoted above, it seems only fair to say that the reader may not agree with many of the author's conclusions about certain reactions.

There are a few misprints that are fairly obvious, but the figures leave something to be desired. This may seem a rather trivial criticism, but the standards of scientific bookmaking are high enough that a potential energy curve drawn with a straightedge seems entirely inexcusable.

The book fills a gap that is entirely lacking in the literature. For we now have a complete statement of the present status of the theory of gaseous kinetics and a comprehensive and authoritative survey of the many reactions that have been investigated. The book should be carefully and seriously studied by all who have any interest in the subject of gas reactions.

Electrolysis of Fused Salts

TECHNISCHE ELEKTROCHEMIE. Vol. III, Schmelzfluss Elektrolyse. By *Jean Billiter*. Verlag Wilhelm Knapp, Halle, Germany. 188 pages. Price, 12.50 M.

Reviewed by C. L. MANTELL

THIS volume deals with production of the light metals from fused salt electrolysis. Sodium takes 44 pages; lithium and potassium together, 1; calcium and barium, 6; beryllium, 8; magnesium, 16; cerium, 4; and aluminum, 81. This distribution of space appears out of proportion to the commercial importance of the metals, but in view of the absence of authentic data on sodium, the discussion on this metal fills a definite gap. The book contains interesting illustrations of operating sodium metal plants. Much of the more important data on the subject appearing in the literature in recent years has found its way into the book.

It is to be regretted that the lithium data are so meager, particularly in view of recent interest in lithium alloys. American developments on beryllium are conspicuous by their absence. The oxide process for magnesium, although no longer in operation, is detailed, while little is given on the Dow company chloride process. The section on aluminum contains considerable data, diagrams, and illustrations which are the same as Edwards, Frary, and Jeffries' "The Aluminum Industry," Vol. I, with some extensions as to Continental practice. Other illustrations are the same as found in "L'Allumino," by Koelliker and Magnani (reviewed in *Chem. & Met.*, July, 1930, p. 437). At the end of the individual treatments, economic data and production figures for the metals are given. These, because of inaccuracies, should not be taken too seriously. The book should be of use to those concerned with fused salt electrolysis in general. For specific data on individual metals, reference texts in English are more useful.

The Facts on Beryllium

BERYLLIUM, ITS PRODUCTION AND APPLICATION. By numerous collaborators; published by the Research Committee of the Siemens-Konzern, Berlin. The Chemical Catalog Co., New York City. 331 pages. Price, $10.

Reviewed by B. H. STROM

IN VIEW of the great interest attracted by recent developments in the metallurgy of beryllium, this comprehensive monograph should be well received. It consists of a series of reports from the electrochemical division of Siemens & Halske A.-G. and from the research laboratory of the Siemens firm, representing years of investigations of the properties and production of beryllium. Preliminary work in the field was started in 1919 by Hans Goldschmidt, inventor of the thermit process, in collaboration with Alfred Stock. The work of these men, to whom much of the success in developing a process must be ascribed, was taken over by a committee for the study of beryllium, later absorbed by Siemens & Halske, originally a member of this committee.

The German process, operating at a temperature of about 1,400 deg. C. and employing a bath of beryllium oxychloride mixed with barium fluoride, is described in detail. Other chapters deal with the dressing of raw beryl and production of beryllium salts suitable for electrolysis; electroplating with beryllium; electrolytic production of beryllium alloys; structure and physical properties of the pure metal and its most important base-metal alloys; and methods of heat treatment and age hardening.

In many respects the high expectations held for beryllium have not come true. The brittleness of the pure metal probably will always be an obstacle to its extensive use in the unalloyed state.

Alloys of beryllium with the other light metals have so far given little promise. Future developments are most likely to be found in the field of heavy-metal alloys containing a comparatively small percentage of beryllium. Many alloys of this type have already been produced which possess extraordinary strength and hardness and remarkable fatigue resistance.

A special chapter lists the most important beryllium minerals, their composition and occurrence. One of the problems was to establish a market for beryl. Exorbitant prices are often asked for this mineral, which is recovered as a byproduct in other mining operations. Investigations into known beryl occurrences should lead to more stable conditions, without which successful development will not be possible.

Society Publications

PROCEEDINGS OF THIRD INTERNATIONAL CONFERENCE ON BITUMINOUS COAL. Prepared and published by Carnegie Institute of Technology, Pittsburgh, Pa., 1932. 2,000 pages. Price, two volumes, $15.

IN THESE proceedings are recorded the complete text of the papers and the verbatim report of the technical discussion at the score or more of sessions of the Third International Conference on Bituminous Coal, held in Pittsburgh, Nov. 16-20, 1931. As a record of current fuel technology and opinion, the two volumes will be widely welcomed. They will have particular interest for chemical engineers and others interested in the processing of fuels, since a large part of the subject matter considered at the conference dealt with processing and utilization of coal rather than with its production and marketing. The volumes should be found in every technical library which pretends to cover the subject of fuels.

ANNUAL REPORTS OF THE PROGRESS OF APPLIED CHEMISTRY, Vol. XVI. Society of Chemical Industry, Finsbury Square, London, England. 742 pages. Price: to members 7s. 6d.; others, 12s. 6d.—As in the past, this annual volume contains technical reports on the significant achievements in chemistry, each section by a different author. It amounts principally to a valuable literature and patent citation, because economic and industrial considerations play a minor part. This British volume, covering progress in the world at large, still manages to outdo its American contemporary, "Annual Survey of American Chemistry," in timeliness by a few months.

Chemistry at the Centenary (1931) Meeting of the British Association for the Advancement of Science. W. Heffer and Sons, Ltd., Cambridge, England. 272 pages. Price, 7s. 6d.—The papers, apart from the inaugural address, are outstanding contributions in various fields of bio- and physical chemistry. There is questionable wisdom, however, in submerging such mixed and rather specialized contributions in a celebration which they do not particularly celebrate.

Annual Reports on the Progress of Chemistry for 1931. The Chemical Society, London. Vol. 28. 443 pages. Price 10s. 6d.—This annual review consists of just a few large sections on the important divisions of theoretical chemistry.

Symposium on the Effect of Temperature on the Properties of Metals. Published jointly by American Society of Mechanical Engineers and American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa. 825 pages. Price, $6.—Papers resulting from the work of a joint committee formed in 1924, divided into sections on engineering requirements for metals and properties of available metals, complemented by extensive indexes and a bibliography.

AMERICAN SOCIETY FOR TESTING MATERIALS, proceedings of the 34th annual meeting. Published by the Society at 1315 Spruce St., Philadelphia, Pa., 1931. Parts 1 and 2, 1,119 and 1,027 pages.—Contains, as usual, committee reports, the latest standards and technical papers.

Pioneering Chemists

DAS BUCH DER GROSSEN CHEMIKER, Vol. 2. By *Günther Bugge*. Verlag Chemie. G.m.b.H., Berlin, 559 pages. Price, 32M.

FORTUNATELY, the publication of this second volume has followed quickly on the first, published in 1929, and thus brought a uniquely valuable work to conclusion in spite of unfavorable commercial circumstances. As was pointed out when the first book appeared, the editor has presented the really decisive events in the history of chemistry through biographies of its most productive leaders, written by some of the foremost figures in science today. The present volume starts with Liebig and proceeds through the momentous leaders of the 19th century, to conclude with Arrhenius, who died in 1927. Eminent among the 27 contributions are the sections on Baeyer by Willstätter; on Meyer, Mendelejeff and Ramsay, by Walden; and on Liebig and Wöhler by Winderlich.

The volume includes an extensive bibliography on the individuals covered and indexes to the complete work. Uniformly with the first volume, the typographic and mechanical treatment are excellent, while the copious illustrative material had the advantage of greater available material in the period covered. Although the book will appeal only to those with some understanding of German, it is regretted that not more space could have been found for such figures as Ostwald, Perkin, and Gibbs, some of whose activities are mentioned.

Texts and Yearbooks

CHEMICAL CALCULATIONS. By *J. F. Long* and *H. V. Anderson*. McGraw-Hill Publishing Co., New York City. 259 pages. Price $1.75—In this edition, as in its predecessor, the fundamental groundwork was found to be too useful to require any but occasional revision. Most of this has been confined to the chapter on volumetric analysis and gas analysis, both of which have been enlarged.

INTRODUCTION TO AGRICULTURAL CHEMISTRY. By *R. Adams Dutcher* and *Dennis E. Haley*. John Wiley & Sons, Inc., New York City, 1932. 484 pages. Price, $4.50.—A new text and reference work on the chemical principles underlying plant and animal growth and nutrition. Copiously illustrated and attentive to the commercial results of biochemical research.

PRINCIPLES OF CHEMISTRY. By *Joel H. Hildebrand*. Third Edition. The Macmillan Co., New York City. 328 pages. Price, $2.25—Revision of a textbook introduced in 1918, stressing the physical fundamentals rather than the elemental peculiarities of chemical behavior.

A COURSE IN GENERAL CHEMISTRY. By *William C. Bray* and *Wendell M. Latimer*. Second Edition. The Macmillan Co., New York City. 159 pages. Price, $1.60—Revised course-plan used in the University of California in connection with Hildebrand's book (above) and serving as introduction to qualitative analysis.

CHEMICAL AGE YEAR BOOK, Diary and Directory, 1932. Benn Bros., Ltd., Bouverie House, London. Price, ½ Guinea.—The annual collection of assorted statistics, tables, and directories.

BRITISH PLASTICS YEAR BOOK, 1932. Published by *British Plastics* and *Molded Products Trader*, London, E.C. 4, England. Price, 7s. 6d.—Arranged rather differently from the American "Plastics Guide Book," this heavy volume contains an editorial section of technical articles on plastics, an alphabetical list of plastics manufacturers in various countries, a directory of proprietary names (very useful, though not complete), directories of supplies and suppliers, and an extensive diary—in short, a desk library for the plastics manufacturer.

SELECTIONS FROM RECENT LITERATURE

ELECTRICAL PROCESS HEATING. *Zeitschrift des Vereines deutscher Ingenieure,* April 9; pp. 353-76. In a special "Electrical Heat" issue, the journal presents papers on process heating as follows: Reinhold Gross, "Electrical Furnaces for Melting Metals and Making Ferro-Alloys": a description of arc, low frequency and induction (high frequency) furnaces, and of reduction furnaces for alloy making. Victor Paschkis, "Electrical Annealing and Hardening Furnaces": recent advances in heating elements, furnace design and maintenance of a desired atmosphere. M. Hirsch, "Drying Ovens": advantages of electrical heat for drying ovens or cupboards, vacuum dryers, etc. A. Petri and E. Kunzig, "Electrical Heat in Agriculture": dryers for potatoes, ensilage and the like; incubators and brooders; apparatus for forcing growth of plants. F. Mörtzsch, "Electric Stoves": laboratory hot plates; ovens and stoves for domestic use and for hospitals and other institutions. E. Rietsch and S. Sandelowsky, "Automatic Resistance Welding Machines": recent advances. There are also brief discussions on thermal efficiency of electric melting of metals; minor applications of electrical heat; electrical hot-water storage systems; heat insulation of electric ovens; measuring temperatures of imbedded heating elements, and new electrical resistance furnaces for use at 950 deg. C. Numerous photographs, drawings and curve charts are shown.

FINE CHEMICALS EQUIPMENT. Otto Gerhardt. *Chemiker-Zeitung,* Feb. 10, pp. 113-4; Feb. 17, pp. 134-6; Feb. 24, pp. 155-6. The production of essential oils, synthetic perfumes and other fine chemicals involves a wide variety of products and a great many processes, but there are a number of unit operations which are quite generally applicable in the industry. Different types of distillation occupy a prominent place among these, with a strong preponderance of vacuum distillation methods and apparatus. Steam distillation, as a variant of vacuum distillation, is also common. For materials which are not too sensitive, use of superheated steam has certain advantages. It is particularly applicable to high-boiling oils which are rich in sesquiterpenes, and to separation of high-boiling constituents from essential oils, medicinals, and the like. There has been considerable development of apparatus suitable for such distillations, including layouts for combining vacuum distillation with the use of superheated steam. This combination requires close control of the supply of superheated steam, but has the advantages of high rate of distillation, heat economy, and mild conditions for sensitive substances. Drawings are shown of vacuum fractionating stills suitable for essential oils. Electrical heating of such stills is to be preferred whenever costs permit. Choice of materials (metals and alloys, stoneware, porcelain, etc.) is discussed with respect to equipment for reactions involving esterification, condensation, saponification, oxidation, reduction, and other operations of organic chemical synthesis.

HIGH-SPEED SPINNING. H. Jentgen. *Kunstseide,* April; pp. 110-116. Viscose silk has been seriously hampered in its competition with acetate silk because its maximum attainable spinning speed has been only 50-60 meters per minute, as compared with 200 or more for acetate silk. Considerable ingenuity was required in overcoming this handicap, because chemical as well as physical changes are involved in the formation of a viscose filament. One of the chief obstacles was the entrained conical liquid column, the height and diameter of which increase as the spinning speed increases. Placing a ring just above the liquid, to strip off the liquid cone, is helpful for small increases in spinning speed, but fails at higher speeds. It was necessary to make radical departures from conventional spinning devices, one objective being to withdraw the filament from the liquid surface in a direction parallel, not perpendicular, to the liquid surface. This expedient effectively prevents entrainment of a liquid column with the filament, even at high speeds. Owing to limitations imposed by centrifugal forces, it is not to be expected that speeds much in excess of 200 meters per minute can be attained, even after all other physical and chemical difficulties have been overcome. In order to achieve the necessary high rate of coagulation, the form of the original cellulose and the ripeness of the viscose are important, and a coagulation accelerator (such as sulphuric acid) must be used; but the viscosity of the viscose has little or no influence. Apparatus is described and illustrated, with which spinning speeds of 200 meters per minute have been attained.

DISTILLATION EQUIPMENT. K. R. Dietrich. *Angewandte Chemie,* March 19; pp. 233-8. The growing demand for absolute alcohol, especially for motor fuel, has greatly accelerated the development of efficient apparatus for distillation of azeotropic systems, and for the lime, anhydrous salt, and vacuum methods of dewatering aqueous alcohol. Among the azeotropic processes, the Usines de Melle system, using apparatus especially characterized by economy of steam, holds high rank. Among liquids suitable for an azeotropic system with alcohol and water, gasoline and benzene each have certain advantages and disadvantages; but suitable blends of the two tend to accentuate the advantages and repress the disadvantages. An elaborate layout is described and illustrated, in which absolute alcohol and aqueous alcohol (in varying concentrations) are both produced at the same time. In lime distillation, the Plestil process has eliminated the necessity of operating under pressure, and gives excellent results with low operating costs and only slight losses of alcohol. The Gorhan process utilizes still different dewatering agents; namely, anhydrous salts such as potassium and sodium acetates. Another process uses calcium sulphate for the same purpose. Vacuum distillation also has been tried, since practically all the water can be removed under suitable conditions; but the alcohol loss through the aspirator is a severe handicap to this method. Whether or not the newer methods can displace azeotropic distillation in actual production depends on the merits of each, in economy, reliability and other factors. Several drawings of distillation layouts are shown.

DRYING AND AIR CONDITIONING. Martin Scholtz. *Melliand Textilberichte,* March; pp. 171-4; April, pp. 229-31. The numerous problems in technology which involve air and its humidity relations are centered chiefly in the operations of drying, cooling, mist removal, and humidification. The Mollier air-humidity chart, dating from 1923, is an important aid toward a clear understanding of the processes involved in these operations. The chart is based on sound reasoning with respect to the physical laws governing the behavior of mixtures of air and water vapor; it proceeds from the simple case of 1,000 g. of dry air mixed with a variable quantity of water vapor. For purposes of calculation, the water vapor is treated as a gas. The mathematical equations which are expressed by the curves on the chart are discussed in detail, and the various uses of the chart are illustrated by calculations. A curve for heat content is included; it is a straight line, in a fixed position on the chart, and so serves as an oblique abscissus for other curves, for heat content calculations. Sample calculations show how changes of state may be followed on the chart, as they occur in drying or in air conditioning. The chart also shows how steam consumption increases as the humidity of the effluent air decreases, and how the whole drying process can be shifted to higher or lower temperature ranges without changing the steam consumption, excepting as it is affected by unavoidable increase in heat losses at higher temperatures.

HEAT EXCHANGERS. F. A. Max Wülfinghoff. *Chemische Fabrik,* March

16; pp. 81-4. Although direct fire heat is still indispensable to heat economy in very large scale applications of heat, indirect heating has many uses and advantages in the process industries. Many designs have been developed for heat exchangers to serve particular purposes, ranging from simple steam coils up to complicated arrangements for flow of two or more liquids or gases in heat exchange relation. In oil refining, and in processing of other heat-sensitive materials, a major advantage in the use of heat exchangers is the possibility of applying heat under controlled, mild conditions which avoid damage by overheating. Various types of heat exchangers are discussed, and numerous drawings are shown. For large-scale operation, apparatus comprising a number of small units has several advantages over a single large heat exchanger. The multiple unit installation is more adaptable to changing requirements, permits cleaning or repairing of single units while the others continue to operate, permits higher rates of throughput, is less sensitive to thermal expansion stresses, and can be constructed from standardized, replaceable parts. Ease of inspection, cleaning and repair are especially important in processing corrosive or highly impure materials; straight, smooth paths should then be provided for liquid flow. More complicated designs are permissible for clean, non-corrosive liquids and for dust-free gases; e.g., for heating or cooling clean air. In one common application—namely, in preheating air with effluent gases from furnaces or the like—a rotary regenerative type of heat exchanger finds considerable use. The heating area is first heated by direct fire, then cooled in contact with the gas to be preheated, and so on.

Recent Government Publications

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from Bureau responsible for its issue.

Rubber Latex. Bureau of Standards, Letter Circular 321; mimeographed. Summary of technology, properties, and use, with bibliography.

Automobile Engine Lubricating Oils. Bureau of Standards, Letter Circular 320; mimeographed. Properties and bases for selection.

Bibliography of Ethylene Dichloride, by W. A. Gersdorff. U. S. Department of Agriculture, Miscellaneous Publication 117; 10 cents.

Conservation of Fertilizer Materials From Minor Sources, by C. C. Fletcher. U. S. Department of Agriculture, Miscellaneous Publication 136; 5 cents. Contains table of typical analyses.

German Lamp Black Industry in Serious Condition, by Consul Sydney B. Redecker. Bureau of Foreign and Domestic Commerce Chemical Division, Special Circular 368; mimeographed.

Foreign Tariffs, by Henry Chalmers. Bureau of Foreign and Domestic Commerce, Trade Information Bulletin 790; 10 cents. A review of current trends and of commercial policies of 1931.

Leather Industry and Trade of the Netherland East Indies, by Carl H. Boehringer. Bureau of Foreign and Domestic Commerce, Trade Information Bulletin 789; 10 cents.

German Chemical Developments in 1931, by Consul General W. L. Lowrie. Bureau of Foreign and Domestic Commerce, Trade Information Bulletin 795; 10 cents.

Market Research Sources. Bureau of Foreign and Domestic Commerce, Domestic Commerce Series 55; 30 cents. A guide to the sources of information on domestic marketing, 1932 edition.

The Effect of Oxygen on Gaseous Hydrogen Sulphide Corrosion of Tank Steel, by John M. Devine and others. Bureau of Mines, Report of Investigations 3160; mimeographed.

Vegetable Tanning Materials. Census Bureau, press release, showing consumption of vegetable tanning materials in 1931 by kinds.

Gasoline Laws and Inspection, by Arch L. Foster. Bureau of Mines, Information Circular 6576; mimeographed. A tabular review of state laws relating to taxation and inspection of gasoline and other petroleum products.

Paraffin and Congealing-Oil Problems, by C. E. Reistle, Jr., and O. C. Blade. Bureau of Mines, Bulletin 348; 55 cents.

Use of Micropyrometer for High-Temperature Melting-Point Investigations, by G. R. Fitterer and M. B. Royer. Bureau of Mines, Report of Investigations 3151; mimeographed.

Abrasive and Industrial Diamonds, by Paul M. Tyler. Bureau of Mines, Information Circular 6562; mimeographed. A résumé of occurrence, uses, and market factors.

Soapstone, by H. Herbert Hughes. Bureau of Mines, Information Circular 6563; mimeographed. A résumé of occurrence, properties, marketing, and price.

Laboratory Batch Still and Fractionating Column for Production and Study of Lubricating Distillates Under Vacuum, by Boyd Guthrie and Ralph Higgins. Bureau of Mines, Report of Investigations 3159; mimeographed.

Motor Gasoline Survey, August, 1931, by A. J. Kraemer and E. C. Lane. Bureau of Mines, Report of Investigations 3162; mimeographed. Part I gives specification data from the survey of samples taken in August, 1931.

Minerals Production Statistics. 1930—final printed separates from the Bureau of Mines on: Cement, by B. W. Bagley, 5 cents; Coke and Byproducts, by W. H. Voskuil, F. G. Tryon and H. L. Bennit, 10 cents; Mica, by B. H. Stoddard, 5 cents; Natural Gasoline, by G. R. Hopkins and E. M. Seeley, 5 cents; Phosphate Rock, by Bertrand L. Johnson, 5 cents; Sand and Gravel, by E. R. Phillips, 5 cents; Talc and Soapstone, by Oliver Bowles and B. H. Stoddard, 5 cents.

Liquid-Oxygen Explosives, by G. St. J. Perrott and N. A. Tolch. Bureau of Mines, Bulletin 349; 25 cents.

Wages and Hours in Rayon and Other Synthetic Yarn Manufacturing, 1930. Bureau of Labor Statistics, Bulletin 546; 10 cents.

Cement. U. S. Tariff Commission, Report No. 38, Second Series; 5 cents. Summarizes the differences in costs of production of roman, portland, and other hydraulic cement and cement clinker in the United States and in the principal competing country.

Safety Codes for the Prevention of Dust Explosions. Bureau of Labor Statistics, Bulletin 562; 15 cents. Gives text of the nine safety codes affecting various manufacturing operations, including starch, flour and feed, grain handling, sugar and cocoa grinding, spice grinding, wood flour manufacture, and pulverized fuel.

Friability, Slacking Characteristics, Low-Temperature Carbonization Assay and Agglutinating Value of Washington and Other Coals, by H. F. Yancey, K. A. Johnson, and W. A. Selvig. Bureau of Mines, Technical Paper 512; 25 cents.

Minerals Production Statistics for 1931—preliminary mimeographed statements from Bureau of Mines on; aluminum salts, bauxite, fluorspar, gypsum, magnesium, magnesite, manganese, molybdenum, mercury, potash, tungsten, rolled zinc, slab zinc, petroleum, petroleum products, and natural gasoline.

Carbonizing Properties of Davis Bed Coal From Garrett County, Maryland, and of Mixtures With Pittsburgh Bed Coal, by A. C. Fieldner and others. Bureau of Mines, Technical Paper 511; 20 cents.

Paper and Pulp Statistics. Census Bureau, unnumbered pamphlet; 5 cents. Summarizes data on production, consumption, equipment, and use for paper, paper board, wood-pulp, and pulp-wood.

Ceramic Statistics. Bureau of Census, unnumbered pamphlet; 5 cents. Summarizes the production statistics for the clay-products industries and for sand-lime brick, including all clay products, non-clay refractories, pottery and porcelain.

Creosote Oil. Tariff Commission, unnumbered pamphlet. A report to Congress on domestic industry producing dead or creosote oil and the import or foreign industry factors affecting it. The printed report will be issued as a Senate Document, obtainable on request from individual Senators, but not from the Tariff Commission.

Feldspar. U. S. Tariff Commission, Report No. 37, Second Series; 5 cents. Summarizes the differences in costs of production of feldspar, crude and ground, in the United States and in the principal competing country.

Glass. U. S. Tariff Commission, Report No. 33, Second Series; 5 cents. Summarizes the differences in costs of production of cylinder, crown, and sheet glass in the United States and in the principal competing country.

Miscellaneous Publications

Beryllium, a Bibliography. Compiled by Mary E. Hoyt and Karl von den Steinen. Colorado School of Mines Quarterly, Vol 26, No. 4. 35 pages. Price, 25 cents.

Life and Work of William Henry Perkin. Published by the Chemical Society, Burlington House, London. 138 pages.—Small appreciative volume on the technical and personal career of Perkin, by several colleagues and friends. Published as a special issue of the society journal.

Destructive Distillation of Corncobs, Experimental Studies. By O. R. Sweeney and H. A. Webber. Bulletin 107, Iowa Engineering Experiment Station, Ames. 15 pages.

Temperature Viscosity Relations in the System CAO-SiO_2-CaF_2-. By C. H. Herty, Jr., F. A. Hartgen and G. T. Jones. Cooperative bulletin 56, Mining and Metallurgical Advisory Board, Pittsburgh, Pa. 45 pages. Price, 50 cents.

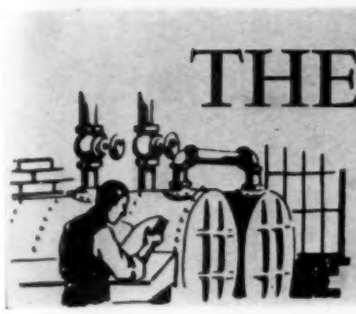
Composition of Low-Temperature Tars: V, Investigation of the Alcoholic Constituents. By Ernest B. Kester and Harold W. Daechner. Cooperative bulletin 54, Mining and Metallurgical Advisory Board, Pittsburgh, Pa. 40 pages. Price, 50 cents.

Catalytic Partial Oxidation of Ethyl Alcohol. By Donald B. Keyes and Robert B. Snow. Bulletin No. 238, Engineering Experiment Station, University of Illinois, Urbana. 38 pages. Price, 20 cents.

International Measurement Units. Tentative American measurement standards. American Institute of Weights and Measures, 33 Rector St., New York City. 56 pages.

Water Pollution, Summary of Current Literature, Vol. V. No. 1, January, 1932. Abstracts Nos. 1-123. British Department of Scientific and Industrial Research. Available from the British Library of Information, 5 East 45th St., New York City. Price, 2s. net.

Review of Iron and Steel Literature for 1931; A Classified List of the More Important Books, Serials and Trade Publications During the Year. By E. H. McClelland. 27 pages. 1932. Carnegie Library of Pittsburgh. This list, reprinted from "The Blast Furnace and Steel Plant" of January and February, 1932, lists 149 books and pamphlets issued in 1931 or late in 1930.



THE PLANT NOTEBOOK

Simple Method of Measuring Three-Phase Power

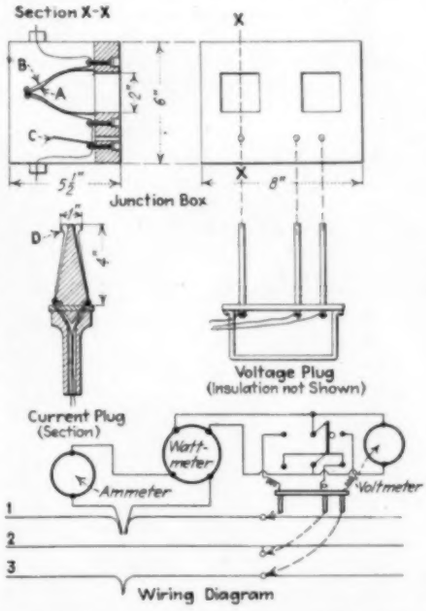
By A. M. White and E. W. Winkler
University of North Carolina
Chapel Hill, N. C.

RECENTLY it has become necessary to measure the power used by motors in the chemical engineering laboratories of the University of North Carolina. The power supply is three-phase, 220-volt, alternating current, and but one wattmeter was available. The electrical hookup chosen for these measurements is well known to electrical engineers, but to chemical engineers unfamiliar with three-phase current, the installation may be of interest.

In the line of each motor for which power measurements are desired is installed a junction box, shown in the illustration, which consists of a soapstone panel pierced by two large holes, each 2 in. square, to receive the current plug, and by three small holes to receive the voltage plug. The current plug, on being pushed into place, separates copper strips, *A*, thus breaking the circuit and passing the current through plug strips, *D*, into the wattmeter. Springs, *B*, made from old hack-saw blades, keep the copper strips, *A*, together when the plug is not in place, and insure good contact when readings are to be made. Line (1) of the three-phase circuit is connected through the left-hand receptacle, and line (3) through the right-hand.

Voltage connections are made by means of the voltage plug which makes contact with the three lead lines through brass strips, *C*. The three voltage taps are fastened in a Bakelite strip, and insulated from the hand of the operator by heavy rubber tubing. The center tap is displaced to one side so that in only one position will the plug fit the openings. The voltage plug is connected to a double-throw, double-pole knife switch, and thence to the voltage terminals of the wattmeter.

To measure three-phase power with one meter, it is necessary to measure the power in two of the three lines independently, and add the two powers algebraically. To take a reading, insert the current plug in the left-hand receptacle, insert the voltage plug, and throw the knife switch to the left-hand position. The wattmeter is then taking its current from line (1), and its voltage drop from lines (1) to (2). After noting the reading, place the current plug in the right-hand socket, at the same time throwing the switch to the right. This arrangement receives its current from line (3), and the voltage drop is that between lines (2) and (3). The sum of the readings in the two positions is the total power.



Junction Box, Plugs and Hookup for Measuring Power With One Wattmeter

For an induction motor running on light loads, one reading usually will be much larger than the other; in fact, one reading may even become negative. If the power factor of the circuit is less than 0.5, one reading of the wattmeter will be negative. In order to know whether the meter reading is positive or negative for a given load it is well to check the orientation of the current plug by applying a load known to have a power factor greater than 0.5. This may be done by imposing a heavy load on an induction motor or by loading the circuit with a pure resistance such as a lamp-bank. Since an increase in load should make both readings increase in a positive sense, loading the circuit indicates the sign of each of the two power readings. If the wattmeter throws to the left instead of to the right, the current plug is rotated 180 deg.

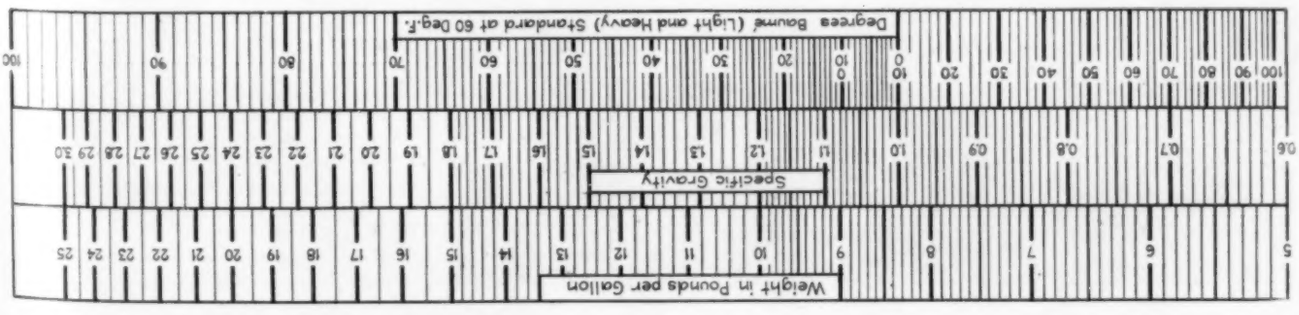
For an induction motor running under heavy load, both readings will be positive and the two will be nearly equal. It is with light loads that particular care must be taken to observe the sign of the two readings. In all cases the total power is the algebraic sum of the powers read in the two positions.

❖

Gravity Conversion Chart

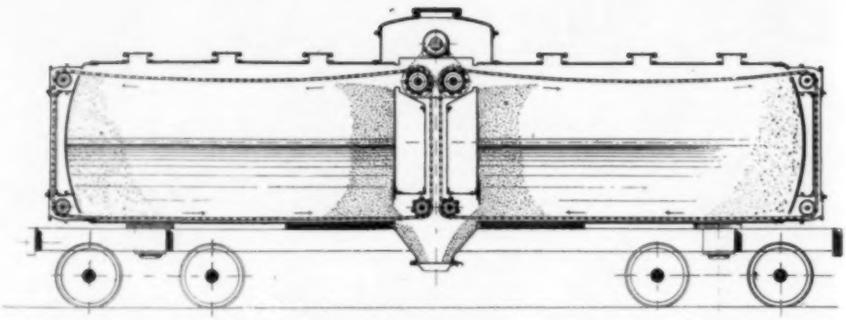
By Arthur K. Doolittle
Chemical Engineer
South Charleston, W. Va.

For the interconversion of degrees Baumé for liquids both lighter and heavier than water, specific gravity, and weight in pounds per gallon, the chart below will be found easy to use and of sufficient accuracy for most purposes.



EQUIPMENT NEWS
FROM MAKER AND USER

Tank Car for Transporting Bulk Solids



Longitudinal Section of Dry-Flo Car Showing Space for Lading, Drive, and Unloading Equipment

GRANULAR COMMODITIES of a density of 25 lb. per cubic foot or more may now be handled in "tank cars" as readily as liquids, according to the General American Tank Car Co., Chicago, Ill. This follows from the development of this company's new "Dry-Flo" tank car which has been designed for the transportation of such solids as cement, lime, silica sand, sulphur, fertilizers, cleaning compounds, soda ash, pottery clays, powdered coal, fuller's earth, glaubers salt, and so on.

With a capacity of over 60 tons for the new cars, savings as high as $120 per car have already been reported in cases where bulk shipment was substituted for sack shipment. That such savings are actually attainable has been proved during an extensive test period. The economy results both from the elimination of package costs and from the reduction in handling. Labor cost is cut out almost completely, while lading costs and possible damage from moisture are reduced to the minimum. However, it is pointed out that the Dry-Flo car is not intended for use with materials that can be transported unharmed in open hopper-bottom cars. In such a case the Dry-Flo car is said to show no savings.

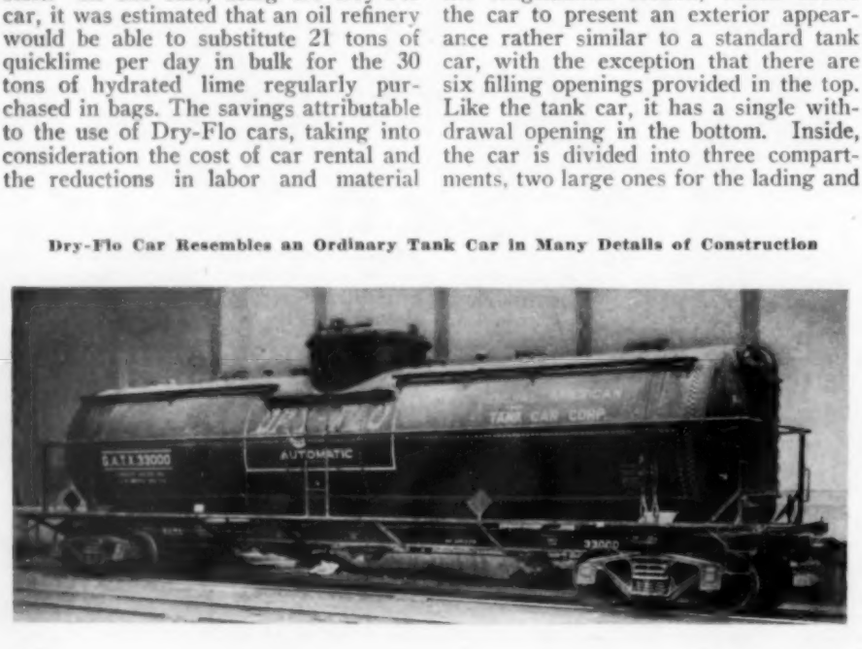
When the material, on the other hand, would otherwise be shipped in packages, savings of as much as $1,000 per car per month are said to be possible. In one case, using the Dry-Flo car, it was estimated that an oil refinery would be able to substitute 21 tons of quicklime per day in bulk for the 30 tons of hydrated lime regularly purchased in bags. The savings attributable to the use of Dry-Flo cars, taking into consideration the cost of car rental and the reductions in labor and material costs, would amount to over $2,900 per month, or nearly $1,000 per car.

In other cases, the possible saving may not be as important as the increased safety or the inherent cleanliness and dustlessness of the Dry-Flo method. In the shipment of arsenic, the saving is estimated to amount to more than $200 per car (60 tons), but in addition, the greater safety of handling is an attractive feature. In the shipment of portland cement in paper-lined box cars which are unloaded with a drag shovel, the substitution of the Dry-Flo car yields no great money saving, but permits a lessened unloading time and turns a disagreeable job into an easy one. There is also a worth-while saving in cement which would otherwise be lost in unloading.

The construction and method of operation of the car are apparent from the longitudinal section, which shows the car to present an exterior appearance rather similar to a standard tank car, with the exception that there are six filling openings provided in the top. Like the tank car, it has a single withdrawal opening in the bottom. Inside, the car is divided into three compartments, two large ones for the lading and a small center compartment containing the conveying mechanism. The latter, which was developed jointly with the Link-Belt Co., consists of power-driven drag chains which are pulled from both sides to the center outlet by means of a motor mounted in the dome, or by external power applied to a shaft provided for the purpose. The power is geared down and provision is made to operate the chains either separately or together. One end may be started alone should the lading be unduly packed or frozen. In unloading, it is necessary only to open the bottom valve and start the conveyors, whereupon the car empties itself.

Unloading time is said to be less than two hours for most commodities. This is at the rate of 400 cu.ft. per hour for each chain. Arching is said to be entirely eliminated by the interior construction of the car, which, in cross-section, presents a round-topped V-shape by virtue of sloping sides installed within the tank. The discharge equipment is arranged to empty the car completely. It is said that no expensive track hopper or system of unloading conveyors is required, a short screw conveyor, either portable or permanently installed, being all that is required.

Dry-Flo Car Resembles an Ordinary Tank Car in Many Details of Construction



❖

Flexible Metallic Tubing

SIZES from ⅛ to 1 in. in diameter are available in a new flexible, metallic tubing of seamless construction which has recently been introduced by the Bendix Aviation Corp., South Bend, Ind. The tubing is said to be suitable for pressures up to 10,000 lb. per square inch and temperatures over 500 deg. F. Construction is of the deep-wall, corrugated type, the tube so produced being protected by a braided metal casing. Each length of hose is supplied with end fittings, brazed or welded to form an integral part of the hose.

New Belt Standard

IT HAS recently been announced by the American Leather Belting Association, 41 Park Row, New York City, that the old weight terminology of "ounces per square foot," previously in use in specifying leather belting, has been discarded by the leather belting industry in favor of a new form of specification based on thickness. The thickness specifications now in effect for first quality leather belting are as follows:

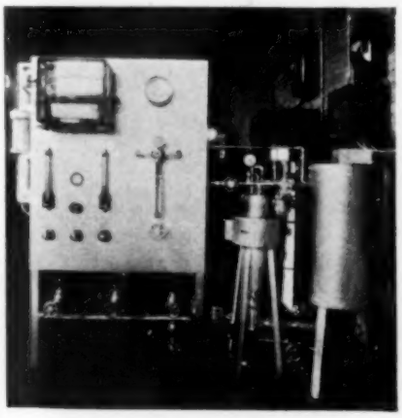
Medium single	10/64 in. to 12/64 in.
Heavy single	12/64 in. to 14/64 in.
Light double	15/64 in. to 17/64 in.
Medium double	18/64 in. to 20/64 in.
Heavy double	21/64 in. to 23/64 in.

These thicknesses are averages and should be determined by measuring 20 coils and dividing the results by the number of coils measured.

❖

Ammonia Dissociator

AMMONIA dissociators in three standard sizes, having capacities of 50, 250 and 600 cu.ft. per hour of liquid anhydrous ammonia, have recently been announced by the Westinghouse Electric & Manufacturing Co.,



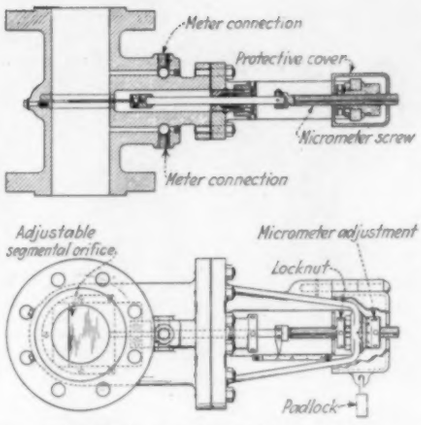
Ammonia Dissociator Installed

Mansfield, Ohio. Conversion with the new dissociator is said to be about 99.5 per cent, each pound of liquid ammonia yielding 45 cu.ft. of dissociated gas consisting, by volume, of 75 per cent hydrogen and 25 per cent nitrogen. At 6 cents per pound for ammonia, the cost of dissociated gas, including operating expenses, is about $1.60 per M cu.ft. With 16-cent ammonia, the cost is about $3.75 per M cu.ft.

❖

Adjustable Orifice

MEASUREMENTS of flow over a wide range may be made with a new adjustable orifice recently designed by the Bailey Meter Co., Cleveland, Ohio. The orifice consists of a flanged body with integral meter connections. The movable orifice plate is set by means of a micrometer adjusting screw with an accuracy of 0.001 in. When it



Adjustable Segmental-Type Orifice

is desired to change the range, it is simply necessary to set the micrometer screw at the reading corresponding to the desired maximum capacity, as obtained from curve sheets furnished with the orifice. The device permits changing the maximum capacity of the meter as much as 40 to 1.

This company also has introduced a new line of recorders and indicators for measuring boiler-drum water level. The mechanism consists of a mercury-sealed bell which measures the differential between the boiler level head and the head in a fixed water leg connected to the steam space. Feed water meters are available installed in the same case and recording on the same chart.

❖

Thermostatic Radiator Valve

FOR THE CONTROL of radiators of all kinds, including unit heaters, building and office radiation, the Powers Regulator Co., 2720 Greenview Ave., Chicago, Ill., has developed a new thermostatic, self-operating radiator valve in which the thermostatic element is located outside the radiant heat zone of the radiator, where it will be influenced only by actual room temperature. The regulator consists of a diaphragm-operated radiator valve connected by armored flexible tubing to a thermostat bulb of large area. According to the manufacturer, the device is sensitive and capable of maintaining the room temperature as set.

❖

Rivet Bolt

A NEW application of the Dardelet screw thread, previously described in *Chem. & Met.*, December, 1929, p. 755, has been announced by the Dardelet Threadlock Corp., 120 Broadway, New York City. This application is the Dardelet "Rivet Bolt," a bolt with a round head and a splined body which is approximately $\frac{1}{32}$ in. larger than the rivet hole. Using a hammer not heavier than 4 lb., the bolt may be quickly driven into the hole, after which the nut is tightened with an ordinary wrench, thus permitting more tension than occurs with the shrinkage of a hot rivet. The special Dardelet thread is similar to the Acme standard with the exception that the bottom of the thread tapers so that a wedging action occurs when the nut is drawn up. Although the nut is readily removable with a wrench, it is asserted that it will never loosen in service.

The new rivet bolt can be made of high-tensile-strength steel, heat-treated if necessary. The over-all cost, in place, is said to be only about one-half as much as that of a hot-driven rivet. It is reported to be suitable for pressure-vessel fabrication, provided that it is installed with a copper gasket. It is also suitable for the fabrication of all sorts of non-pressure joints.

❖

Combustion Controller

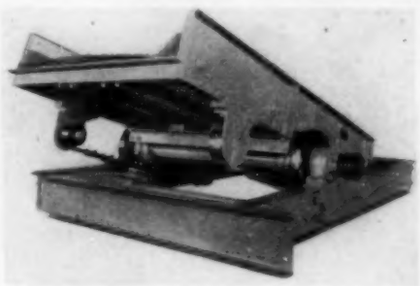
WHERE it is desired to vary the setting of fuel valves or dampers in direct relation to boiler-pressure changes, the new Type EK regulator made by Morey & Jones, Ltd., 922 South Hemlock St., Los Angeles, Calif., is applicable. A pilot valve spring is set to balance the required boiler pressure which is exerted on a diaphragm. As the pressure goes above the set point, steam from the header or some other constant-pressure fluid is admitted to exert pressure on the main regulator diaphragm. When the diaphragm moves, an automatic compensating arrangement avoids overtravel or hunting, preventing further movement until it is required by further change in the conditions or until a reverse action is needed. These regulators are suited to the handling of pressures from 2 to 500 lb. The regulator arm movement may be varied over a wide range to suit various control conditions.

❖

Heavy-Duty Vibrating Screen

AN ACCOMPANYING illustration shows a new single-deck model of eccentric vibrating screen recently developed by the Link-Belt Co., 910 South Michigan Ave., Chicago, Ill. This type of screen can be furnished with any desired fixed amplitude. The angle of screen inclination, the speed of operation and the direction of rotation are all readily changed at any time to suit the kind, size, and condition of material to be screened. The screen is available also in double-deck models. In a modification of this screen, known

Single-Deck Eccentric Vibrating Screen



as the unbalanced-pulley type, the amplitude can be varied by the user from nil to about ¼ in., simply by changing counterweights in the vibrating mechanism.

❖

Vaporproof Gage

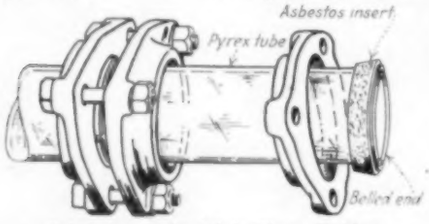
TANKS need not be opened for gagging if they are equipped with a new form of tank gage recently announced by the Tokheim Co., Cedar Rapids, Iowa. As the gage mechanism is fully inclosed, it is said to eliminate the escape of vapor and the danger of static explosions in the measuring of flammable liquids. The gage has the further advantage that it brings the level reading to a convenient point, readily accessible to the operator.

The gage consists of a counterbalanced float attached to a metal tape marked in inches and fractions of an inch. This tape is inclosed within a pipe outside the tank and the tape readings are visible through a window.

❖

Pyrex Tube Couplings

TIGHTNESS and easy demountability are important factors of a new joint recently developed by the Corning Glass Works, Corning, N. Y., for joining the Pyrex glass tubing which it manufactures for industrial use. The several parts of this coupling are shown in the accompanying drawing. The tubes are produced with a slight flare at the ends, but this flare is small enough so that flanges may be slipped over the end of the tube. In order to bring the flange to bear against the tube, an asbestos insert is placed between the belled end of the tube and the flange. The flange-face gaskets supplied are of unique design, it is said, insuring perfect centering. These gaskets are available in blue African asbestos or in special pressed paper. The ends of the tubes are ground and grooved so as to insure tightness of the joint against pressures up to 50 lb. without excessive tightening of the flange bolts.

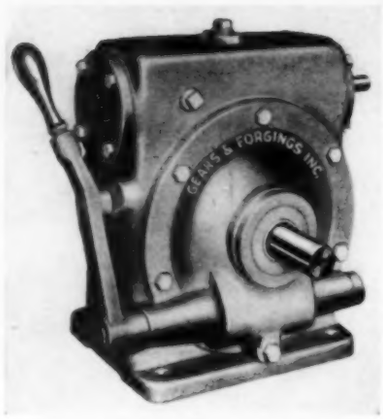


Joint for Industrial Glass Tubing

❖

Two-Speed Reducer

BOTH HORIZONTAL and vertical drives are available in a new ½-hp., two-speed reducer recently introduced by Gears & Forgings, Inc., Cleveland, Ohio. This reducer is supplied either integral with the motor or as a separate reduction unit in ratios ranging from 4:1 to 150:1. The unit consists of a worm and worm gear and a set of differential gears, operating on roller bearings in a leakproof and dustproof housing. Speed change is accomplished by means of the differential gearing.



Two-Speed, Worm-Gear Speed Reducer

This company has also announced a new speed reducer of the planetary type built integral with an electric motor, forming a single compact unit available in 34 standard ratios up to 240:1, in sizes from ¼ to 30 hp. This form of reducer is recommended by the manufacturer for applications where available space for the driving mechanism is limited. The design is said to be simple and troubleproof.

❖

Car-Loading Conveyor

IMPROVEMENT in the car-loading conveyor announced in the March, 1931, issue of *Chem. & Met.* has been made by the Clark Tructractor Co., Battle Creek, Mich., in the new "Kar Kit" conveyor which is capable of handling bags, bales, bundles or other packages at a speed of 90 ft. per minute.

The improved conveyor is similar to the "Twinveyor" previously described with the exception that the parallel spiral tubes which convey the packages by virtue of their rotation are mounted on casters for ready placement. As the device is reversible, it may be used for both loading and unloading. In connection with standard "Twinveyors," it can draw from, or deliver to, distant points in the plant.

❖

Flame Arrester

IT HAS RECENTLY been announced by the Vapor Recovery Systems Co., 2820 North Alameda St., Compton, Calif., that Underwriters' Laboratories approval has been obtained on the "Varec" entrainment separator flame arrester made by this company. This approval lists the device "for installation within 15 ft. of the open end of a vent pipe" as well as "for installation between a vacuum and pressure vent valve and an oil tank." According to the manufacturer, this is the only arrester which carries the latter quoted approval.

Feed-Water Regulator

BOILERS operating under rapidly fluctuating loads generally require a type of feed-water control which will take into consideration both the water level in the drum and the rate at which steam is flowing from the boiler. This has been accomplished by the Northern Equipment Co., Erie, Pa., in its new Copes "Series-Type" regulator by making use of two thermostatic elements coupled together, one of which responds to boiler-lever fluctuations and the other to changes in the rate of steam flow. These thermostats are similar to the single units regularly employed in thermostatic feed-water regulators. The improvement consists in adding the second thermostat for taking steam flow rate into account.

❖

Lead Pipe Standards

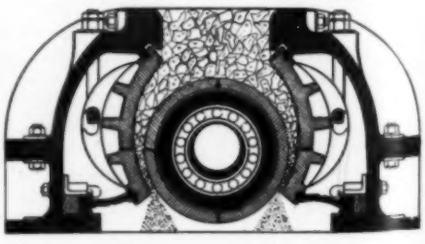
NEW STANDARDS for lead pipe size have recently been approved by the Lead Industries Association, 420 Lexington Ave., New York City, and are being adopted by the principal lead pipe manufacturers. In addition to eliminating numerous variations in pipe sizes that have been found among the products of different manufacturers, an outstanding feature of the new standards is that all sizes of lead pipe in the A, AA and AAA classifications ("strong," "extra strong," and "double extra strong") will safely withstand constant cold water pressures of 50, 75 and 100 lb. per square inch, respectively. Heretofore, the safe working pressures of these classes of pipe has decreased as the diameter of the pipe increased. The principal changes occur in diameters of 1 to 2 in.

❖

Gyro-Centric Crusher

UNDER the name of "Gyro-Centric," Patterson Machine & Foundry Co., East Liverpool, Ohio, has put on the market a novel form of crusher in which a cylindrical, horizontal crushing element, driven with an eccentric motion, crushes material against concave pressure plates. Construction of the machine is indicated in the accompanying drawing. It will be observed that the eccentric crushing action is obtained without rubbing, a fact which is said to result in a minimum production of fines. It is further stated that the entire crushing chamber is utilized, since crushing action takes place almost im-

Cross-Section of Gyrating Crusher



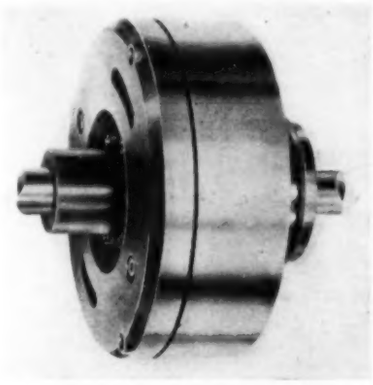
mediately upon feeding rock into the hopper. From that point gradual reduction takes place until material reaches the desired size. It is to be noted that the cylindrical crushing roll is the only moving part of the entire assembly and that it does not revolve with the shaft but creeps slowly, so that wear is said to be distributed evenly over its entire circumference.

These mills are available in a large range of sizes and capacities and are suitable for the reduction of stones, coal, grog, ore, cement, glass and similar minerals, and synthetic products.

❖

Magnetic Friction Clutch

SMALL size and powerful action characterize a new magnetic, friction-type clutch developed by the Dings Magnetic Separator Co., Milwaukee, Wis. The clutch has contact faces on both sides of a spring disk and these



Magnetic Friction-Type Clutch

faces are "squeezed" between the magnet and armature elements when the coil is energized. The power transmission is said to be about 75 per cent greater than that of a single friction contact face with the same magnet strength. The company has also developed a single-spring disk clutch with three friction contact faces for still greater torque and power transmission.

Dings has also announced a new induction-type, high-intensity, magnetic separator for effecting separations between such faintly magnetic materials as slate from gypsum or coal. It is asserted that other faintly magnetic materials such as biotite, muscovite, and pure oxide of iron may be successfully separated from minerals such as feldspar and silica.

❖

Adjustable Ventilating Fan

DESIGNED especially for installation in ducts, the new adjustable-volume ventilating fan recently announced by Vallen Electrical Co., Akron, Ohio, can, according to the manufacturer, be set to attain maximum efficiency under all operating conditions. The fan shaft is at right angles to the motor driving shaft, with power transmitted through specially constructed gears to provide a positive drive. All shafts are carried on ball bearings. The motor shaft is extended so that the motor is installed outside the duct. The fan blades, which are of the propeller type, are of adjustable pitch so that the desired fan performance for any sort of installation may be attained.

❖

Isolant for Vibration

DEVELOPED a number of years ago in Germany, "Keldur," a synthetic rubber-like product for vibration isolation, is now being manufactured and sold by the Keldur Corp., 26 Ave. B, Newark, N. J. This material has a high damping effect and is recommended for use under fans, motors, presses, galvanometers, balances and other equipment. It is ordinarily loaded to between 10 and 30 lb. per square inch and is usable to temperatures of 140 deg. F. It is available in sheets ranging from $\frac{1}{4}$ to $\frac{1}{2}$ in. in thickness.

The efficacy of this material, as is explained by the manufacturers, is based on the fact that it combines in one material the action of soft springs and good hydraulic shock absorbers. That is, it is said to have very high compliance and very high damping. It is claimed to be permanent and unaffected by oils. It is volumetrically incompressible, resembling rubber rather than cork in this respect.

❖

Worm Gear Reducers

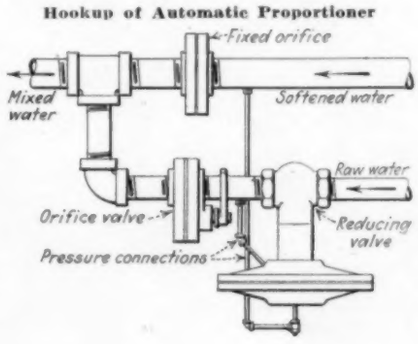
FIVE models are available in the new Size 5-HG worm-gear speed reducer recently announced by Foote Bros. Gear & Machine Co., 215 North Curtis St., Chicago, Ill. These models provide for almost any desired arrangement of the input and output shafts. The new reducers are available in a wide range of ratios, varying from 3.5:1 to 3,000:1. All of them employ anti-friction bearings and all are installed in oil-tight and dustproof cast-iron housings.

❖

Automatic Proportioner

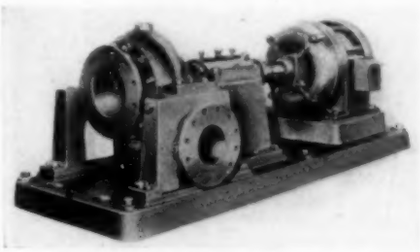
DEVELOPED primarily to control the mixing of raw and softened water for boiler feed, a new automatic proportioner recently placed on the market by the Elgin Softener Corp., Elgin, Ill., is also suitable for the mixing of other liquids in constant proportions.

Hookup of Automatic Proportioner



The device is shown in the accompanying drawing to consist of two orifices and a reducing valve. The orifice in the upper line is fixed. That in the lower line, in series with the reducing valve, is an adjustable "orifice valve." The pressure behind the orifices is communicated to the two sides of the reducing valve diaphragm so that the flow in the lower line will be maintained by the reducing valve in some constant relation to the flow in the upper line as determined by the setting of the orifice valve. This proportioner is available in a wide range of sizes.

❖



New Type 8SA Pump for Acid

Acid-Resisting Pump

PARTS coming in contact with acid are constructed of chrome steel in a new centrifugal acid pump for process work which was recently announced by Allis-Chalmers Manufacturing Co., Milwaukee, Wis. To insure uniform expansion from the center of the pump when handling acids at high temperature, the casing is supported on the horizontal center line by brackets and it is also keyed on the vertical center line underneath the water-cooled stuffing box. The pump is so constructed that the rotating element can be removed through the suction end without disconnecting the discharge piping or casing brackets or disturbing the motor.

❖

Safety Mat

TO PREVENT slipping in chemical plants and to avoid shock hazards in the operation of electrical machinery, Melflex Products Co., 1833 East Market St., Akron, Ohio, has developed a new thread-inserted rubber mat which is said to be both oil- and acid-resisting. The tread consists of strips of heavy tire cord bound together by live rubber and firmly imbedded vertically in a base of tough rubber. The cord strips are separated by grooves and are said to present an absolutely non-slip surface.

❖

Automatic Starting Clutch

IT HAS just been announced by the Ramsey Chain Co., Albany, N. Y., that the company has acquired exclusive manufacturing and sales rights in the United States for the Pulvis clutch originally described in *Chem. & Met.* on page 443, July, 1930. Under the name of the Ramsey-Pulvis clutch, the device is being built in standard sizes

ranging from 0.1 hp. at 600 r.p.m. to 122 hp. at 800 r.p.m. Special units can be designed to transmit up to 400 hp. at 200 r.p.m.

The clutch consists of a cylindrical shell with corrugated interior, connected to the driven machine. A hub carrying wings is free to rotate within the shell. The hub is coupled to the motor. Hardened steel shot placed within the shell serves as a centrifugal coupling medium between hub and shell, gradually accelerating the driven equipment to motor speed, but only after the motor has attained its rated r.p.m. Overloads cause slippage within the clutch, which, therefore, absorbs shocks which might otherwise damage the motor.

❖

Vacuum Toggle Switch

FLAMEPROOF, corrosion-proof construction is provided in a new toggle switch recently introduced by the Burgess Battery Co., 202 East 44th St., New York City. This switch is suitable for intermittent current to 8 amp. or continuous currents to 6 amp. at 220 volts. It employs the Burgess vacuum switch, in which the contacts are sealed in vacuum and the making and breaking motion is conveyed through the glass stem of the vacuum chamber. The switch is actuated by an ordinary toggle movement.

❖

Corrosion-Resisting Castings

CROLL-REYNOLDS Engineering Co., 17 John St., New York City, announces that it has arranged to handle "Ni-Resist" castings manufactured by its associate, the Weatherly Foundry & Manufacturing Co., under license from the International Nickel Co. Croll-Reynolds is prepared to offer engineering and metallurgical services on standard and special castings of this material to be used for heat and corrosion resistance.

❖

Portable Recording Pyrometer

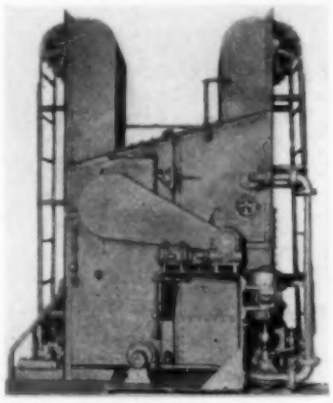
ELECTRIC operation is employed in a new portable recording pyrometer recently announced by the Hoskins Manufacturing Co., Detroit, Mich. The instrument weighs 17 lb. and is arranged for simple wall mounting if desired. The chart is driven by a self-starting synchronous electric clock. Records consist of a series of overlapping dots recorded every 30 seconds by the impress of a stylus on carbon paper back of the chart. The meter is equipped with automatic cold-end compensation and is calibrated for Chromel-Alumel thermocouples.

Portable Recording Pyrometer

❖

Solvent Washing Machine

FOR CLEANING metallic parts before painting, lacquering, enameling, plating, vitreous enameling, or applying other surface coatings, Rex Products & Manufacturing Co., 13005 Hillview Ave., Detroit, Mich., has developed a new type of solvent washing machine in which the work is carried by conveyors between powerful streams of boiling solvent. The solvent used is known as "Perm-A-Clor," which is a non-explosive, non-flammable material said to be permanent in quality and free from acids. Work is first carried downward, being struck by streams of solvent under a pressure of 35 lb. per square inch; then over and upward, permitting the work to drain. Then it passes through a rinse of distilled hot solvent, after which it passes upward and leaves the machine clean and dry.



Vertical Solvent Cleaning Machine

❖

Vacuum Refrigeration System

COOLING of water to temperatures from 32 to 50 deg. F. is possible with a new vacuum refrigeration system recently announced by the Foster Wheeler Corp., 165 Broadway, New York City. The equipment used is shown in the accompanying line drawing to consist of a flash chamber, evacuated by a thermocompressor which discharges to a condenser. The water to be cooled is fed into the flash chamber where it boils at reduced pressure, the heat for the boiling being derived from the heat of the water itself. Through the use of the thermocompressor, it is possible to maintain a higher vacuum than that corresponding to the available condenser water supply, thus permitting water temperatures in the flash chamber that are lower than that of the cooling water. Cold water is then withdrawn from the flash chamber by means of a centrifugal pump and circulated to the apparatus to be cooled.

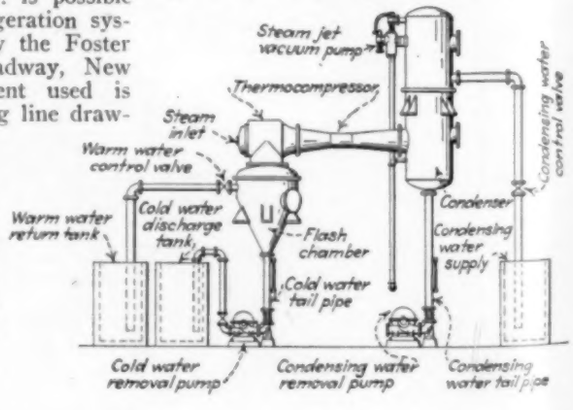


Diagram of Vacuum Refrigerating System

❖

Portable Electric Lantern

"ECOLITE" is the name of a new portable electric lantern, made by the Economy Electric Lantern Co., 325 West Huron St., Chicago, Ill., recently put on the market and passed by the Underwriters' Laboratories for use in Class 1, Group D, hazardous locations. The lamp is so arranged that the removal or breaking of the lens immediately opens the circuit, eliminating any possibility of ignition from the lamp filament. Further safety features include a spark-proof base, wireless switch, safety finish, and other features said to reduce hazard to the minimum.

❖

Explosionproof Starter

MOTORS up to 30 hp. at 220 volts, or 50 hp. at 440 or 550 volts, may be controlled with three new sizes of automatic, explosion-proof a.c. starter, recently announced by Cutler-Hammer, Inc., 219 North 12th St., Milwaukee, Wis. These starters are intended for Underwriters' Laboratories Class 1, Group D, hazardous locations such as gas plants, oil refineries, coke plants, and chemical works. These starters are of the broad-flange type and require no oil. They are provided with thermal overload protection.

❖

Improved Gas Mask

FOR industrial use, E. D. Bullard Co., 275 Eighth St., San Francisco, Calif., has developed a new gas mask with a one-piece molded face-piece which is held snugly in place without binding, by means of a new form of suspension. The rubber used in the mask is said to be specially compounded so as to retain its elasticity. The mask has been designed for use with a refillable canister

which is said to offer exceptionally low breathing resistance. Triangular eyepieces are used to give maximum horizontal and vertical vision and it is stated that they never fog on the inside.

❖

Safety Carboy Tilter

EASE of application and safety in operation are said to be principal features of the American Safety Carboy Tilter, made by the American Pulley Co., Philadelphia, Pa., and offered for sale by the Merrimac Chemical Co., Everett Station, Boston, Mass. The tilter consists of a pair of bow-shaped elements attached to a steel frame. The frame is placed on the carboy and locked in position by turning a clamping screw. The carboy is then rocked on the bow-shaped elements and may be handled under complete control throughout the pouring movement.

Manufacturers' Latest Publications

Agitation. Bingham Pump Co., Portland, Ore.—15-page reprint of a paper on improved agitating methods and scientific consistency control in the manufacture of pulp and paper.

Apparatus. American Platinum Works, N. J. R.R. Ave. at Oliver St., Newark, N. J.—Leaflet describing improved offset rims used on platinum ware.

Baffles. Boiler Engineering Co., 744 Broad St., Newark, N. J.—6-page folder describing the Beco-Turner baffle wall and showing numerous typical installation illustrations.

Bearings. Auburn Ball Bearing Co., 57 Clarissa St., Rochester, N. Y.—36-page book illustrating and describing this company's line of ball-thrust bearings.

Boilers. Foster-Wheeler Corp., 165 Broadway, New York City—Bulletin B-32-3—48 pages on the various types of boilers manufactured by this company.

Buildings. International-Stacey Corp., Columbus, O.—48-page catalog of this company's subsidary, The International Derrick & Equipment Co., covering standardized industrial steel buildings.

Burners. Lee B. Mettler Co., 406 S. Main St., Los Angeles, Calif.—Catalog C2—16-page booklet illustrating and describing this company's "C Series" of conversion gas burners for heating-boiler firing.

Chemicals. Roessler & Hasslacher Chemical Co., Empire State Bldg., New York City—Publications as follows: 32-page quarterly price list of chemicals made by this company; 24-page book entitled "Peroxygen Compounds"; leaflet briefly describing typical uses of sodium perborate.

Chemicals. G. Frederick Smith Chemical Co., 867 McKinley Ave., Columbus, O.—33-page pamphlet on the use of ceric sulphate as an oxidizing agent; 64-page pamphlet on the analytical applications of periodic acid and its salts.

Clarifiers. Hardinge Co., York, Pa.—Bulletin 38—11 pages on clarifiers for water purification, trade waste, and sanitation treatment.

Controls. Detroit Lubricator Co., Detroit Mich.—Catalog G—Loose-leaf catalog of Mercoid controls for the regulation of temperature, pressure, vacuum, liquid level, and other factors.

Corrosion Tester. American Instrument Co., 774 Girard St., N.W., Washington, D. C.—Bulletin 1506—4-page booklet on a salt-spray corrosion test chamber.

Diesels. Worthington Pump & Machinery Corp., Harrison, N. J.—S-500-Series Bulletins—Covering four-cycle direct-injection stationary diesel engines in sizes ranging from 50 to 1,000 hp.

Disintegration. Paul O. Abbé, Inc., Little Falls, N. J.—Catalog N—120 pages on porcelain jar mills, steel pebble mills and ball mills; also mixers.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—Publications as follows: GEA-19G, Magnetic switches; GEA-1542, Direct-current motors; GEA-1565, Magnetic reversing switches; GEA-1587, Combination magnetic switch; GEA-1588, Explosion-proof magnetic switches.

Electrical Equipment. Monitor Controller Co., Baltimore, Md.—Bulletin describing the principle of operation of the Monitor accelerator made by this company for the starting of direct-current motors.

Electrical Equipment. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.—Circulars 1937 and 1939—Two 8-page circulars illustrating and describing this company's new line of "De-Ion" circuit breakers with description, details of construction, and information on applications.

Emulsions. Carbide & Carbon Chemicals Corp., 30 E. 42d St., New York City—55-page booklet on the preparation of emulsions and other products, using triethanolamine; covers a wide range of emulsified products, giving considerable information on emulsion ingredients, procedure, formation of emulsions and mechanical operations; describes specifically a number of formulas and methods of production.

Fans. The Allen Corp., 14th Ave. at Howard St., Detroit, Mich.—4-page folder describing a new line of propeller-type exhaust ventilating fans.

Filters. Alsop Engineering Corp., 39 W. 60th St., New York City—4-page folder describing this company's electrically operated asbestos disk filters.

Filters. Fish-Schurman Corp., 230 E. 45th St., New York City—12-page catalog describing fritted-glass filters for laboratory use, manufactured by the Jena Glass Works. Also lists filter funnels and other accessories.

Fuel Burning. Combustion Engineering Corp., 200 Madison Ave., New York City—Three 8-page reprints discussing respectively the combination burning of blast-furnace gas and pulverized fuel, the tangential firing of gaseous and liquid fuels, and the corner firing of blast furnace gas.

Gas Indicator. Mine Safety Appliances Co., Pittsburgh, Pa.—Bulletin 72—4 pages on this company's portable combustible gas indicator for testing explosive gas hazards.

Gaskets. Minnesota Mining & Manufacturing Co., St. Paul, Minn.—14-page booklet describing the properties required in fiber packing gaskets and showing how these requirements are met in the "Tan Fibre" gasket made by this company.

Heating. H. O. Swoboda, Inc., 5530 Forbes St., Pittsburgh, Pa.—Bulletin 270—Illustrates and describes bare electric immersion heating units for large tanks; 8 pages.

Heating Equipment. W. S. Rockwell Co., 50 Church St., New York City—Publications as follows: Bulletin 325, Rockwell blast gates; 327, Rotary carburizing furnaces for electricity or fuel; 328, Rotary heat-treating furnaces for ferrous and non-ferrous metals; 329, Pusher-type continuous furnaces; 330, Electric and fuel industrial furnaces; 331, Blowers and data on air handling; 332, Electric convector furnaces; 333, Belt-conveyor-type continuous furnaces; 334, Non-ferrous billet heating furnaces.

Instruments. The Bristol Co., Waterbury, Conn.—Catalog 1011—11 pages on the Bristol recording absolute-pressure gage.

Instruments. Esterline-Angus Co., Indianapolis, Ind.—Bulletin 2321—8 pages completely describing this company's line of remote-metering equipment.

Instruments. Leeds & Northrup Co., Philadelphia, Pa.—Catalog 40—32 pages on apparatus for the measurement of electrical resistance.

Instruments. Republic Flow Meters Co., 2240 Diversey Parkway, Chicago, Ill.—Catalog 401—24 pages illustrating and describing and listing users of this company's CO_2 meter.

Laminated Materials. Spaulding Fibre Co., Tonawanda, N. Y.—4-page folder of engineering information on the properties and uses of Spauldite laminated phenolic sheets.

Level Recorders. Bailey Meter Co., 1050 Ivanhoe Road, Cleveland, O.—Bulletin 112—8 pages on boiler-water-level recorders.

Lubricants. Acheson Oildag Co., Port Huron, Mich.—23-page technical bulletin on the properties, uses, and advantages of colloidal graphite as a lubricant.

Materials Handling. Diamond Rubber Co., Akron, O.—Well-illustrated booklet showing applications of belt conveyors in 27 different industries.

Metals and Alloys. Associated Alloy Steel Co., Cleveland, O.—20 pages on the properties and uses of "Nevastain RA," a new, patented corrosion-resistant steel alloy containing 16 per cent chromium and smaller percentages of manganese, silicon, copper and other elements. It is said to be readily welded, formed, and machined.

Metals and Alloys. International Nickel Co., 67 Wall St., New York City—30-page book on the "Application of Monel Metal and Nickel to Industrial Processing Equipment." Charts list a large number of materials, show where these materials are used, and show the applications in these connections for Monel metal and nickel. Also Bulletin T-3, a 12-page article on the corrosion of metals by sulphuric acid.

Microscopes. Bausch & Lomb Optical Co., Rochester, N. Y.—6-page folder describing this company's new unified-slit ultramicroscope for the study of colloids.

Oil Seals. Aetna Ball Bearing Manufacturing Co., 4600 Schubert Ave., Chicago, Ill.—16-page booklet describing and showing applications of a new type of oil seal made by this company.

Power Generation. Troy Engine & Machine Co., Troy, Pa.—Booklet giving six typical performance surveys showing savings effected through the use of steam-engine drives.

Pumps. Northern Pump Co., Minneapolis, Minn.—Bulletin PX4—Describes Nitralloy steel pumps of the gear type in capacities ranging from 6 to 42 g.p.m. for pressures up to 1,000 lb. Except for their larger size, these pumps are identical with those described in *Chem. & Met.*, March, 1932, page 164.

Pumps. Worthington Pump & Machinery Corp., Harrison, N. J.—Bulletin D-450-B7—4 pages on vertical sump and irrigation pumps; bulletin W-321-SIA—8 pages on Monobloc centrifugal pumps.

Pyrometers. Bacharach Industrial Instrument Co., 7000 Bennett St., Pittsburgh, Pa.—Bulletin 296—11 pages on this company's Type HK disappearing-filament optical pyrometer, with information on construction, use, and accessories.

Pyrometers. The Foxboro Co., Foxboro, Mass.—Bulletin 182—16 pages on the potentiometer control pyrometers and electric-resistance-bulb-thermometer temperature controllers made by the Wilson-Maulen Pyrometer Division of this company.

Refractories. E. J. Lavino & Co., Bullitt Bldg., Philadelphia, Pa.—Bulletin 1-13-17—folder on this company's chrome brick, describing the entire line of standard 9-in. sizes; bulletin 1-21-1, folder on "Wet-Krome" ready-mixed chrome cement.

Relays. American Instrument Co., 774 Girard St., N. W., Washington, D. C.—Leaflet describing supersensitive relays for controlling relatively heavy current through the limited mechanical impulse of thermostat action or photoelectric cell control. Fifty-watt type uses open contacts; 1320-watt type uses vacuum contacts.

Sample Storage. R. P. Cargille, 26 Cortlandt St., New York City—Circular 10—Folder describing new models added to this company's line of sample storage boxes.

Spray Nozzles. Monarch Manufacturing Works, Salmon and Westmoreland Sts., Philadelphia, Pa.—Bulletin 6-C—16 pages describing stoneware, hard rubber and metal spray nozzles and strainers, atomizing nozzles, regulating and cut-off valves.

Tablet Apparatus. F. J. Stokes Machine Co., Tabor Road, Olney P. O., Philadelphia, Pa.—20-page folder describing tablet machines, mixers, dryers, and coating pans made by this company.

Testing. Baldwin-Southwark Corp., Philadelphia, Pa.—Bulletin 28—36-page illustrated book describing and illustrating testing machines and stress-strain recorders that have been built by this company.

Tungsten Carbide. Stoody Co., Whittier, Calif.—Folder describing and listing prices of this company's "Shape Borium," specially shaped pellets of tungsten carbide for tools and hard facing.

Warehouses. Distribution Service, Inc., 445 W. Erie St., Chicago, Ill.—Geographically arranged directory of the warehouses holding membership in this organization. Facilities of each group of warehouses are illustrated and described.

Water Purification. Industrial Chemical Sales Co., 230 Park Ave., New York City—20-page booklet concerning the use of this company's activated carbon in the production of palatable drinking water.

Water Purification. The Permutit Co., 440 Fourth Ave., New York City—28 pages on the principles of water filtration, the treatment of different classes of waters, the various types of chemical feeds and equipment for water treatment.

Wire Rope. American Cable Co., 230 Park Ave., New York City—Booklet giving the 12 "Cardinal Reasons Why Tru-Lay Wire Rope Saves Money."

X-Ray. Claud S. Gordon Co., 708 W. Madison St., Chicago, Ill.—Folder illustrating the type of information obtainable from X-Ray photographs of welds.

NEWS *of the* INDUSTRY

Activities Reported by Mellon Institute

ACCORDING to the nineteenth annual report of the director, Dr. E. R. Weidlein, to the trustees of Mellon Institute of Industrial Research, Pittsburgh, Pa., the sum of $722,541 was received by the institution from industrial fellowship donors during the year ended February, 1932, in which 75 industrial fellowships, employing 176 scientists and engineers, were in operation. At the close of the year 58 fellowships were active, and of these, 28 have been at work for five years or longer and 13 have concluded more than ten years of research. Among the achievements of 1931-32 summarized in the report are the results of the air-pollution investigation, the iodine investigation, organic synthesis, petroleum production, protected metals, and the steel fellowships, and the sugar investigation.

The constructional work on the institute's new building is proceeding satisfactorily; it is thought that this edifice will be completed and ready for occupancy in the summer of 1933.

❖

Course in Enameling At Cleveland Plant

THE Ferro Enamel Corp., Cleveland, Ohio, is giving a course in advanced methods of porcelain enameling in its plant during the week of June 20. The class is open to porcelain enameling executives, operators, and suppliers. Emphasis will be placed on study of production methods, process control, wage incentives, and shop troubles. Outside lecturers from prominent enameling plants will supplement classroom study.

❖

New York Electrochemists Will Meet May 20

THE final meeting of the New York section of the Electrochemical Society for the present season will be held on Friday evening, May 20, in the new McGraw-Hill Building.

Election of officers for the 1932-1933 season will open the program, followed by two papers from the staff of Union Carbide & Carbon Research Laboratories, Inc. The first will be by B. E. Field, on "The Corrosion-Resistant Hastelloy Alloys." These alloys are finding wide application because of their indifference to attack by many chemicals, and their resistance to chlorine and hydrochloric acid. The second paper, by J. H. Critchett, will cover "The Manufacture and Use of Ferrochromium With Particular Reference to the Stainless Steels and Irons."

At the end of the technical session an opportunity will be given to inspect the McGraw-Hill Building. The meeting will be preceded by an informal dinner in the McGraw-Hill clubroom. Ladies are especially invited to both dinner and meeting.

❖

South Seas Phosphates Offered in Canada

REPORTS from Vancouver, British Columbia, say that J. M. Thompson, of the British Phosphate Commission, operator of the phosphate industry on Nauru Island, recently arrived in that city, to confer with officials of the Consolidated Mining & Smelting Corp., Dr. S. F. Tolmie, premier of British Columbia; William Atkinson, Provincial Minister of Agriculture, and government and agricultural leaders in Canada. Mr. Thompson is desirous of developing the market for phosphates from the South Seas. United States export statistics record shipments last December of 9,162 long tons of high-grade phosphate rock to Canada from the Montana and Idaho district.

❖

Herty Presented With Institute Medal

THE annual meeting of the American Institute of Chemists was held in New York City on May 7. The meeting closed with a dinner at the Chemists' Club at which the institute medal was presented to Dr. Charles H. Herty, "for noteworthy and outstanding service to the science of chemistry and the profession of chemist in America." Dr. Henry G. Knight, president of the institute, presided at the dinner. Dr. Frederick E. Breithut, retiring president, acted as chairman. The presentation speech was delivered by Francis P. Garvan, president of the Chemical Foundation. Other speakers included Dr. M. T. Bogert, of Columbia University; Dr. John H. Finley, of the New York *Times;* Henry W. Jessup, and Joseph E. Ransdell.

Volatile Poison Bill Goes To Surgeon General

HEARINGS on the Volatile Poison Bill proposed by Senator Bingham, held before the Senate Committee on Agriculture and Forestry on April 19-20, resulted in referring the bill to the Surgeon General of the Public Health Service. He is requested to investigate the general question of health hazards resulting from the use in the household of such materials.

The original legislation took the form of a drastic bill first announced by Senator Bingham nearly a year ago, but finally introduced in a much modified form. That bill, modified by two minor amendments also introduced by Senator Bingham, was the basis of the hearing.

Senator Bingham and Prof. Yandell Henderson, of Yale, who was the sponsor of the bill, spoke in defense of the measure. Written protests had been received from members of the chemical and insecticide trades, but the only witness heard was Warren N. Watson, secretary of the Manufacturing Chemists' Association, who said the association was anxious to cooperate in securing safety in the use of its products. He then explained the difficulty which would result from further complicating the regulatory measures affecting many industrial chemicals listed in the bill. He pointed out that as the bill was drawn it would lead to many absurd conclusions. He stated, for example, that there was sufficient chlorinated hydrocarbon in insulated copper wire and that certain stained shingles contained enough other proscribed compounds that both under the law would have to carry the skull and crossbones poison label and antidote instructions. These absurdities made even Dr. Henderson confess that a complete redrafting of the measure would be highly desirable.

❖

Manufacturing Chemists Will Meet June 2

The annual meeting of the Manufacturing Chemists' Association will be held at the Seaview Golf Club, Absecon, N. J., June 2-3. The executive committee of the association met in the Chemists Club, New York, May 10.

The insecticide committee of the association will meet in the Chemists Club May 20, to map out a program of research work for the ensuing year.

I. G. Farbenindustrie Cuts Dividend Rate

DIRECTORS of I. G. Farbenindustrie of Germany have recommended a dividend of 7 per cent, as against the 12 per cent rate which was paid in the preceding year. They also proposed to the general meeting that the company's holdings in its own shares to the value of 110,000,000 marks shall be cancelled, thus reducing the ordinary share capital to 685,000,000 marks.

The report for 1931, states that the company succeeded in escaping the serious effects of last year's grave international credit crisis owing to its liquid assets and the absence of bank debts, but has suffered indirect losses in consequence of the international disturbances of payments and commercial business, and the difficulties confronting exports in general. Gross profits fell from 217,480,000m. last year to 155,310,000m., or by 30 per cent. Net profits were almost haived, having declined from 95,160,000m. in 1930 to 51,460,000m., including the carry forward.

The company's plant and equipment is entered at 456,500,000m., against 494,190,000m., in the previous year; participations, excluding the company's own shares, have been lowered from 301,190,000m. to 275,330,000m, and stocks in hand from 307,290,000m. to 238,910,000m. Sales of dyestuffs and auxiliary products remained stable, a decline in the European markets having been compensated by an improvement in oversea trade. Business in general chemicals is described as satisfactory. The turnover in pharmaceutical products underwent a substantial increase, and photographic materials also went fairly well on the whole. Sales of rayon increased by a quarter, but prices suffered from keen competition and the decline in prices for other textile raw materials. The depression in nitrogen continued, the company's home sales having dropped by almost one-fourth, whereas sales to foreign countries were maintained, and in a few cases increased. Business in synthetic nitrogen was considerably smaller than last year. Technical progress has been made in the field of distillation, and production costs have been reduced; but the production of synthetic petrol will continue to result in a financial loss as long as the severe competition exists in the German market. During the current financial year the difficulties in the way of business, the report states, have undergone a further substantial increase, and sales are declining further.

❖

A. I. Ch. E. Will Celebrate Silver Anniversary

THE silver anniversary of the events which led to the founding in the winter of 1907-08 of the American Institute of Chemical Engineers will be celebrated on the occasion of the winter meeting of the Institute to be held in Washington, D. C., Dec. 7, 8, and 9. The program for the winter meeting will include also a special session on patent problems affecting chemical engineering and a symposium dealing with some of the outstanding economic questions affecting the profession and the industries which it serves.

Arrangements for the convention are under the general chairmanship of Russell S. McBride and the program of papers is being organized by Harrison E. Howe. The other members of the institute resident in and near Washington make up the convention committee, including H. K. Benson, Hardee Chambliss, W. M. Corse, Warren E. Emley, P. H. Groggins, H. T. Herrick, R. H. Kean, C. J. Lauter, Henry C. Parker, Charles L. Parsons, Walter R. Russell, J. W. Turrentine, and W. N. Watson. The council of the institute has authorized the selection of the Hotel Washington as convention headquarters.

❖

Importers Protest Against Duty on Sugar

IMPORTERS of sugar have filed a brief with the U. S. Tariff Commission protesting against the proposal to increase the duty on sugar. The brief contends that export prices of the refiners are materially less than domestic quotations.

The domestic refiners, the importers declare, are asking the Commission to subsidize obsolescence when they seek relief from competition due to newer and more modern methods of refining. "A domestic refinery system shown to be more than 60 years old seeks protection of its investment as against newer and more efficient methods requiring far less capital outlay," is the wording set forth in the brief presented.

In reply to testimony placed before the Commission citing two cases of failures among refiners—the Texas City Sugar Refining Co.—and the Federal Sugar Refining Co.—the brief contends that these failures were not caused by importations of refined sugar and that these firms were in financial difficulty for a number of years before Cuban refined sugar entered the United States in appreciable quantities.

❖

Study as Antidote To Depression

DURING the depression the study of American engineering practice by foreign countries has gained, according to the Engineering Societies Library, which conducts a world-wide technical information service. Requests for aid from both the Soviet Government and U. S. engineers in Russia indicate increasing reliance on this country there; inquiries from New Zealand, relating largely to public works, are numerous.

For the first time, however, the general demand from industry for technical assistance is falling off. The number of readers, on the other hand, has shown a 10 per cent increase in recent months.

Natural Gas Research at University of Alberta

DURING the last year the waste natural gas in Alberta, particularly in the Turner Valley, has continued on an increasing scale. As a consequence, the associate committee on gas research of the National Research Council of Canada has concentrated its efforts on the utilization of this gas.

Extensive research has been carried out in the laboratories of the University of Alberta. Viking gas has been used in these experiments. It is almost sulphur-free, but contains a smaller proportion of the higher hydrocarbons than does the gas in the Turner Valley, the methane content being about 93 per cent as calculated from combustion analysis. In order to find catalysts which might promote the formation of ethyl alcohol from water gas or from a mixture of carbon dioxide and hydrogen, a series of experiments was carried out on the decomposition of alcohol, on the principle that a catalyst which promotes a given reaction will also promote the reverse reaction.

No catalyst has yet been found which will give a clean decomposition, but some of those tried have produced carbon dioxide and hydrogen almost exclusively. When water gas under a pressure of 2,500 lb. was heated in a glass-lined steel reaction chamber in the presence of a catalyst it gave mixtures of acetic acid, methyl alcohol and water, without any carbon deposit.

Work was carried out on the heat-treatment of natural gas, and in particular the relation between the yields of solid and liquid hydrocarbons, the composition of the gas, and the temperature of the reactions. The gas was passed at different rates through quartz tubes in order to vary the time of contact, the temperature used being in the neighborhood of 1,000 deg. C. There proved to be an optimum time of contact for the maximum yield of liquid products and another for the formation of acetylene. Ethylene, on the other hand, did not reach a maximum, the yield increasing with rising temperature and decreasing time of contact. The light oils produced in the reactions were collected by means of charcoal. The liquid consisted of 81 to 90 per cent benzene, about 10 per cent toluene, and a small naphthalene fraction, the total being 12 per cent of the theoretical.

❖

Russia Opens Phosphorous Production Unit

A REPORT from our trade commissioner at Paris states that the French press has carried announcements to the effect that the official institute of chemistry at Moscow has constructed an experimental triphase electric oven for the extraction of yellow phosphorus from apatite. Results obtained are said to have been favorable and it is planned to install larger size ovens of this type in the new synthetic fertilizer plants.

NEWS FROM WASHINGTON

By Paul Wooton

Washington Correspondent of Chem. & Met.

WASHINGTON is recovering its senses. It is the shattered confidence of business that now presents the real danger, because Congress either will discard the outrageous proposals that have the country by the ears or President Hoover, now asserting his leadership in a very positive fashion, will veto them.

A billion dollar tax bill comprehends all that business will have to bear, as defeat of the bonus, now regarded as certain, will carry with it all other proposals that promise a cure-all by redistributing wealth or tearing down the capital structure by debasing currency.

A good prayer for any business man would be that the Senate push through the tax bill and adjourn early in June. Because a large proportion of the economies claimed in appropriation bills will be back in deficiency bills, the tax bill won't balance the budget, but that issue will not come up again until next winter. In the meantime, industry, able to pay strict attention to business, may discover that there is profit in small as well as large operations.

According to reports received in Washington, this adjustment seems to be well under way in the chemical industry. With production in step with consumption, the pace is painfully slow, but the footing is firm. Inflation resulting from the Federal Reserve credit expansion may serve to jog business into a livelier gait, but, as Eugene Meyer remarked anent the Goldsborough bill, you can't compel a man to run 100 yards in 10 seconds when such a feat is a physical impossibility for him.

IN THE Goldsborough bill, the wish is father to the thought. The overwhelming vote by which this measure passed the House reflects the yearning of Congress to quicken the pulse of business. This it succeeded in doing, but with fright rather than hope, and when doctors disagree, it is difficult to anticipate what the effect will be on the patient. The Maryland Senator would have the Federal Reserve banks buy government bonds at the rate of $100,000,000 a week until the wholesale price index rises to the 1926 level. This is greatly to be desired, but Governor Meyer insists that forcing the supply will not create a demand for credit. He argues that the 1926 level may be the point to which prices will return or it may not. Fixing the price level by controlling the volume of money, he says, would be very difficult without also controlling the volume of production. Velocity or turnover as well as volume figures in credit operation. Federal Reserve notes issued against government bonds will immediately return to the banks if there is no use for the money. Senator Goldsborough's bill is the product of the kind of thinking that Washington is now swinging away from, and even if it weathers the rapidly concentrating opposition in the Senate, it will be killed by a veto.

The first aid necessary to cure Congress of its hysteria has diverted attention from the comparatively small affairs which normally claim interest. Veto of the annual Muscle Shoals bill has been invited by the House by stipulating that the government undertake operation of the fertilizer plants unless a lease is negotiated within 18 months. The bill gained many votes from those who declared that they are opposed to government operation but argued that unless threatened with such competition, no private firms would consider an operating lease.

With a view to obtaining establishment of standards for disinfectants of the coal-tar and pine-oil types, the Insecticide and Disinfectant Manufacturers' Association has sponsored a bill by Senator Copeland to bring these products under the Insecticide Act of 1910. The bill would require a label declaration of the phenol coefficient according to methods prescribed by the Secretary of Agriculture. Disinfectants recommended for use against pus-forming organisms also would be required to carry a statement on the label indicating to the consumer how the product should be used. The bill is not likely to receive further consideration this session, but the united indorsement of the trade is expected to carry it to enactment in due time.

STRONG sentiment for revision of the anti-trust laws has been dissipated in too many proposals. Congress isn't anxious to tackle a job when nobody can agree on how it's to be done, especially when price fixing and control of production are still anathema to the rank and file of constituents. Suspicion also attaches to the innocent proposal to restore the effectiveness of the Federal Trade Commission's procedure for codifying trade practices and helping business to rid itself of those that are either unlawful or unhealthy.

Business men who would like to abolish the Commission have dragged a herring across the trail by suggesting that new legislation to legalize trade practice agreements is not necessary. They argue that by utilizing the U. S. Arbitration Act passed in 1925 any industry with initiative and courage can write and enforce its own code of business conduct without interference from or affirmative action by the government. The 1925 statute provides for settlement by arbitration of disputes in commercial and maritime transactions. The argument put up to the Senate Judiciary Committee is that this statute can be invoked in the fight to suppress bad trade practices if any group that adopts a code will agree in advance to submit all questions that subsequently arise to a board of arbitrators composed of representatives of their own industry. Appeal to the courts is available if the judgment of the arbitrators is not respected. The procedure under the Arbitration Act would not, however, extend immunity from the threat of prosecution for violation of the anti-trust laws that is sought by advocates of the Nye bill.

WITH a bumper crop of failures already harvested by the depression, the new strict bankruptcy bill doesn't have much chance. Enactment of previous statutes followed hard on the heels of depression, but such laws were lenient, representing a desire to clean the slate following the panicky years of 1797, 1837, and 1867. Regarded as emergency measures, these laws were repealed soon after the country put hard times behind. Not until 1898 did Congress enact a law that stuck. Born of the panic of 1895, this law, with amendments, is still in effect today. Based on the theory of creditor control, the law has broken down primarily because of the failure of creditors to press their claims.

Another objection is that the bill extends the government's supervisory powers at a time when public sentiment is hard against any more government in business, although expenses of administration would continue to come out of the bankrupt estates. The original bill has been buried under a flood of amendments, and hearings in progress before the joint congressional committee promise to continue indefinitely. The committee is in no haste to push the bill, preferring rather to study the whole situation thoroughly before submitting its recommendations to either House or Senate.

Protest of the Rubber Manufacturers' Association against the import tax of 5c. per pound on rubber and on the rubber content of manufactured products proved unavailing. Although the tax was laid on by the Senate Finance Committee without notice to the industry, it is understood that the proposal was suggested by the Treasury Department in a desperate hunt for revenue just before the bill was reported, May 9. It is estimated that the tax will produce $53,000,000. Some credence is placed in the rumor that the tax was advocated by manufacturers who are long on rubber, but there is also a suggestion that, by amendment on the floor, the tax will be applied to existing stocks. Totaling 337,000 long tons, stocks are abnormally large, representing approximately 13 months' supply.

British Chemical Manufacturers Plan to Increase Production

Interest in New Processes Keener Than in Recent Years

From Our London Correspondent

POLITICAL and tariff questions still overshadow the industrial outlook, but on balance British chemical industry has resasonable grounds for restrained optimism, and signs are not wanting that manufacturers are not only planning for increased production but are already far more willing to consider new processes and developments than they have been for many years. Imperial Chemical Industries is perhaps an exception, except as regards developments which fit very obviously in its present program. This is understandable because there always is a tendency in the early days of such a large merger to give the benefit of the doubt to development which would obviously be rejected when financial resources are not so liquid. One interesting exception is the reported acquisition by I.C.I. of a license from Siemens and Halske to manufacture beryllium at the works of one of its associated companies near London. This is a relatively small development, but may ultimately have considerable importance in view of I.C.I.'s diverse interest in the metal field.

Beryllium has frequently been referred to in these notes, and in linking up with the pioneers in research and manufacture, one is on safer ground than in following up independent processes and inventions, which so often ultimately revert to the successful pioneers. It is too early to say whether there can be any material reduction in the cost of manufacture of this important metal, but it is clear that even $25 per pound would be an optimistic estimate of the sale price two or three years hence, and the figure of $10, at which the metal would have more extended commercial application, still seems a pious hope.

THE annual report of I.C.I. was more or less in accordance with expectations; and has been reported fully in the technical and daily press. One cannot blame the directors for painting the best picture that circumstances justify, but, shorn of all trimmings, it is clear that no profit would have been earned and no dividends distributed were it not for the very profitable sales of soda and chlorine products. Some of the associated and subsidiary companies engaged on specialized lines, among which may probably be included the dyestuffs group, also earned profits, but these undoubtedly were counterbalanced by losses elsewhere, and unfortunately in some cases there is no likelihood of these losses being converted into a profit in the near future.

The position of the Billingham nitrogen factory is of vital importance in considering future prospects. Both the nitrogen plant and the coal and oil hydrogenation plants at Billingham have had to be written down substantially, and there is little doubt that this will have to be continued for some years, because today's replacement value of the Billingham factory is probably $40,000,000 less than its actual cost. One could not expect assets to be written down straightaway on such a heroic scale, and the directors probably are wise in waiting for a year or two to see which way the fertilizer cat is going to jump. Present indications are that Billingham will be able to pay its way, and when it is showing a profit, the outlook for I.C.I. can be viewed with more equanimity than at present.

As regards the hydrogenation of coal and oil, while it is satisfactory to learn that all patents and research activities have been pooled, it will be some years before the valuable results obtained can be translated into practice, for without state subvention or support the present prices of oil and gasoline would make operations unprofitable.

FROM the tariffs, the chemical industry is bound to benefit during the next year or so, and in particular from any revival of the basic industries of the country. Competent observers regard the whole situation purely as one for gradual adjustment, accompanied by a domestic rise in price, and a gradual reduction of the present benefits accruing from tariffs and the depreciated value of the pound. The main hope is that England will not make the mistakes which tariffs have induced in other countries, and that the old tradition of aiming at the maximum of import and export trade will still be upheld, the adventitious aids being regarded as temporary palliatives.

Prof. R. H. Pickard has been nominated as president of the Society of Chemical Industry for the ensuing year. A man of vigorous outlook and capacity, amply proved in his professorial work and as director of research for the Shirley Institute for Cotton and Textile Research, Prof. Pickard will have no difficulty in maintaining the high traditions of his office. Sir William Pope is to receive the Messel Medal of the society at the annual meeting at Nottingham in July. The society is maintaining its position very well considering the depressed state of industry, which presses with undue hardship on technical men, but here again the energy of its staff and council is likely to be rewarded after a year or two of quiet and relative inactivity.

A VERY important paper was recently presented to the Institute of Metal by Bengough and Whitby, who are on the staff of the chemical research laboratory of the Department of Scientific and Industrial Research at Teddington. Dr. Bengough was the originator of the anodic process for obtaining with the aid of electrical current protective oxide coatings on the surface of aluminum and its alloys, and these have proved extremely useful in connection with the development of aircraft, in spite of certain disadvantages as regards their application and the results obtained. The protection of magnesium alloys from corrosion from atmosphere and chloride solutions, especially sea water spray, has presented grave difficulties, and the present paper relates to a new method of protection obtained by immersing or coating the specimens in solutions of sodium selenite, or in selenious acid solutions containing a small percentage of sodium chloride. The results obtained exceeded all expectations, and were also definitely superior to those developed at the Royal Aircraft establishment at Farnborough where alum bichromate and sulphate bichromate solutions were used.

Dr. Bengough's work on corrosion in general has been of outstanding merit, and is the result of patent investigation and research for many years. It is understood that experiments are being continued in order to develop the best means of protection for aluminum alloys, and in this connection it is of interest to record that progress is now also being made with the "Panalumin" process of Protective Coatings, Ltd., which also is an immersion process not requiring the use of electric current. The "Panalumin" solutions are applicable also to magnesium, but probably are not so effective as the new selenium method; on the other hand, they have proved their value on aluminum and its alloys and particularly as a primer coating for paint and lacquer. In addition, very effective colored and iridescent effects are obtained by these solutions, and may do a good deal in extending the use of aluminum for decorative and architectural work.

Further progress is reported in regard to development in the Scholler-Tornesch process for the production of sugar and alcohol from wood cellulose, which was reported in these notes last November. It is stated that the yield of glucose obtained from dry wood is 60 per cent by weight, and that only 0.1 per cent of acid is required. The capacity of the Tornesch plant is to be increased and the operating cost is given as 0.1 Mark per liter of alcohol, working under the most economical conditions. Of the glucose produced, only about 60 per cent is fermentable, the conversion requiring 8 to 10 hours.

Overproduction Adds to Depression Of German Chemical Industry

Decline in Price and Demand for Nitrogen Has Wide Effect

From Our Berlin Correspondent

THE CRISIS in the chemical industry continues unabated. Markets are dwindling and overproduction is gaining as outside territories are disappearing behind barriers of various sorts. The iron industry seems to have reached the bottom; only necessary replacements are being made and stocks are lower than ever before. In consideration of this fact and the further one that the Russians are taking 100,000 tons of rolled steel every month, it is hoped that at least the present low level can be maintained for some time. The Ruhr coal industry shows more resistance; its business has declined about 40 per cent from 1929, while iron has shrunk by 70 per cent. Of course, the possibility of maintaining the present status is slighter than in the case of iron.

The report of the I. G., like the recent report of the U. S. Department of Commerce on Germany, illuminates the status of the entire industry. Dividends for 1931 were cut to 7 per cent from 12 per cent previously. The most serious decline has been in the nitrogen business; other important groups, such as special dyes and chemicals, have shown a compensating stability. Pharmaceuticals and insecticides, as well as photographic chemicals, are still showing a satisfactory turnover. Besides nitrogen fixation, which used to be responsible for a major part of the revenue, rayon has been very disappointing. So has the hydrogenation of lignite for gasoline, in which there is a heavy research investment. Rayon consumption has increased in quantity, but prices are too low to be lucrative. Nitrogen showed a satisfactory stability throughout the first part of the year and domestic consumption decreased only one-quarter in all; but with the break-up of the international cartel last summer an almost prohibitive competitive situation has been created, which does not promise to be cleared in the early future. Production of nitrogen products has been cut down to a point where stocks can be decreased. With the new year, a further price cut occurred, but through a guarantee of the government, the domestic fertilizer trade has revived.

THE price of synthetic gasoline has been lowered in order to make more use of the Leuna plant. But the situation in the world's motor fuel market has not permitted profitable operation, in spite of high tariff protection. Meanwhile the report of the American I. G. Chemical Corp. of New York is anticipated in the early future.

Chaotic conditions have developed in the gasoline market, accompanied by bitter controversies in the press. The Russians declare that they have not carried on price cutting, whereas the other interests, including English and American firms, accuse them of violating agreements. It is a fact that the import of Russian petroleum products has grown greatly at the expense of the other interests. German gasoline and benzol producers hope to better their positions by higher tariffs, which naturally creates an uproar in the automobile industry. Therefore a new gasoline tariff probably cannot soon be expected.

The first German Dubbs cracking plant has been erected by McKee & Co., of Cleveland, for the refinery at Misburg, and has gone into operation for a capacity of 75,000 tons annually. The question of whether to crack for gasoline or lubricating oil was decided in favor of the former by investigations of Egloff and Nelson. They obtained from native petroleum 55 to 68 per cent of gasoline with an octane number of 75 to 73. The Shell and Standard companies are interested in this refinery.

EXPERIMENTS for the bacterial removal of poison from illuminating gas, conducted by Lieske, of the Kaiser Wilhelm Institut, has progressed to the point where their practical utilization will soon be undertaken. Waste sludges, such as occur in municipal clarifying plants, contain bacteria which will convert carbon monoxide, either pure or in mixtures, into carbon dioxide and hydrogen, in the presence of water. A secondary process then begins, in which the carbon dioxide reacts with the hydrogen present to form methane and water, so that the carbon monoxide is definitely removed. The activity of the bacteria can be animated fivefold by increases in temperature.

Along the same lines, deodorants are being developed to be added to illuminating gas. The Galician Naphtha A.G. has developed a product called "Detektol" requiring 0.25 gr. per cubic meter of gas, while the "Calodorant No. 3" of the Standard Oil Co. requires 0.6 gr. Detektol is a polymerization product of cracked gasoline and concentrated sulphuric acid. It boils between 30 and 220 deg. C. and contains 6½ per cent sulphur.

Dekalin, which has been produced for over ten years by the Deutsche Hydrierwerke, has always been prepared from naphthalene by way of tetraline. By means of a new catalyst, it is now possible to make dekalin directly from naphthalene. The process is not only considerably cheaper but also better qualitatively; the specific gravity is lower and the boiling point limits are closer. Dekalin is widely used as a solvent in the preparation of special soap and textile preparations, in the extraction of coal, recrystallization of crude anthracene, solvent for used rubber, and as plasticizer of threads and fibers.

A new synthetic resin series has been prepared by Keller and Nüssler from ammonium thiocyanate and guanidine. It is produced as a resinous mass which can be mechanically worked and which can be formed as a powder, with or without fillers, in the press. Its electric conductivity is lower than that of marble. A new firm, H. Geldmacher, Vergisch, Gladdach, is now producing silk glass wool. As in the United States, it is intended primarily for insulation and for liquid and gaseous filtration.

❖

Domestic Potash Production Increased Last Year

POTASH produced in the United States in 1931 according to the U. S. Bureau of Mines, amounted to 133,920 short tons of potassium salts, equivalent to 63,880 short tons of potash. Sales by producers amounted to 133,430 tons of potassium salts, with an equivalent of 63,770 tons of K_2O. The potash materials of domestic origin sold by producers in 1931 were valued at $3,086,955. About 20,000 tons of potassium salts with an available content of 10,500 tons of K_2O remained in producers' stocks Dec. 31, 1931. The output increased 26.5 per cent in gross weight with an increase of 4 per cent in K_2O content. The sales of salts increased 36 per cent, with an increase of 12.6 per cent in K_2O content. The total value of the sales increased 3 per cent. About the same amount of crude salts remained in the hands of producers at the end of 1931 as at the end of 1930.

The increase in production was due to the opening of the potash-bearing mine near Carlsbad, N. M. This together with potash obtained from salines in California and from distillery residue from molasses in Maryland formed the greater part of the production in 1931. Alunite was shipped from Sulphur, Nev., to California, ground and sold as fertilizer, and a small amount was also produced at Marysvale, Utah. Cotton boll ash also was sold as a fertilizer.

❖

Cellophane Production Started in Canada

Reports from Canada state that production of cellophane has begun at the new plant of Canadian Industries, Ltd., which was recently completed at Shawinigan Falls at a cost of $1,000,000. Many of the raw materials used in the new cellophane plant are obtained from other plants of Canadian Industries, Ltd.

French Chemical Producers Report Lower Profits

From Our Paris Correspondent

INDUSTRIAL and economic conditions have not changed in recent weeks and there is no indication that activities in French industries will improve in the near future. An important obstacle in the way of effecting a remedy for conditions so unfavorable to domestic and foreign trade is found in excessive fiscal charges with public budgets constantly increasing. High labor costs also contribute largely to the depressed state of affairs. Wages have almost doubled compared with pre-war standards, although the cost of living is now indexed at 115, with the pre-war level representing 100. Prices for raw materials as a rule are below those ruling in 1913-1914. Yet labor is opposing any salary or wage cut, despite the large number of unemployed. Hence many industries—for instance, the textile and silk plants in the northern and eastern districts and at Lyons—have been forced to curtail production by as much as 50 per cent.

The position of the chemical industry last year is being definitely indicated by the financial statements which are being issued by leading producing companies. Balance sheets of Société des Matières Colorantes de St. Denis show profit of a little over eight million francs for 1931, compared with eleven and one-half million francs for 1930. The Société de Saint Gobain earned forty-two million francs in 1931, against eighty-eight million francs in 1930.

AS FAR as the Kuhlmann and Péchiney companies are concerned, the results of the last working year have not yet been published but Kuhlmann, as we hear, intends to pay the same dividend as in the preceding year. With regard to the latter concern, which is the most important aluminum producer in France, a fact that tends to prove a notable fall in its profits is that the quantity of bauxite extracted in 1931 aggregated 300,000 tons, as against the record figure of 650,000 tons in 1929.

Referring to aluminum, it should be mentioned that the "Bureau International de l'Aluminium," in Paris, this year has renewed its international contest with a donation amounting to 100,000 francs for the best inventions or industrial processes likely to improve or develop the production or applications of aluminum and its alloys.

It may be interesting to point out that the use of complete manures containing phosphoric acid, potash, and nitrogen is steadily increasing, while on the contrary that of superphosphates obtained by treating natural phosphates with sulphuric acid or by industrial treatment of bones is constantly decreasing.

With regard also to potash-bearing materials, it is to be noted that Poland has now entered the group formed by European producers. The Société Polonaise de l'Exploitation des Sels Potassiques entered into an agreement with the Franco-German potash syndicate according to which the company is being alloted the whole of its home market besides a 4 per cent quota in the supply of the requirements of foreign markets.

Among chemical industries that are most affected by prevailing conditions, that of gelatin is of special interest. This market has been severely disturbed, owing to Russian dumping flooding the market with cheap products of inferior quality; depreciated sterling checking exports into Great Britain of French pastes and glues; and lastly, owing to the Japanese, who, since the start of the Sino-Japanese conflict, have stopped all export shipments to the Far East.

❖

New Chemical Society Active in Brazil

THE Society of Chemists of Rio de Janeiro, established by a governmental decree some six months ago, has recently displayed interest in obtaining foreign contacts, according to a report from our trade commissioner at Rio de Janeiro. It already has over one hundred industrial chemists among its members. It holds semi-monthly meetings for the reading of technical papers and publishes a journal, *Revista de Chemica Industrial*. It also maintains a library and a permanent committee to assist importers in matters of tariff classification of incoming goods and similar matters. The society is divided into technical sections according to the industrial interests of its members, such as sections on vegetable oils, paints and varnishes, metallurgy, etc.

❖

Southern Alkali Buys Gas and Oil Outputs

ADVICES from Houston, Texas, say the Southern Alkali Corp., subsidiary of American Cyanamid Co., has bought the gas on 2,678 acres of Saxet field in Nueces County, with a total of six producing gas wells and estimated potential daily production of 150,000,000 cu.ft. of gas. The acreage is in the heart of the field. In addition, Southern Alkali has bought the oil on half of 600 acres.

❖

Flexible Tariff Provisions Held Valid

PROCLAMATIONS by the President increasing the rates of duty on three items under the so-called flexible provision of the tariff, have just been held valid by the U. S. Court of Customs Appeal in a decision reversing the Customs Court for ruling that the President might not change the wording of a paragraph. All of the protests originated under the Act of 1922, but the decision has force under the present law.

Group Meetings Feature A.C.S. St. Louis Meeting

WITH an attendance of approximately 225 members, the eleventh Mid-west regional meeting of the American Chemical Society opened at the Coronado Hotel, St. Louis, Mo., May 5. Group meetings were held throughout the day on May 6 with papers presented devoted to the fields of petroleum, pharmaceuticals, corn products, and chemical education. The papers on petroleum dealt principally with chemical engineering aspects of design of distillation equipment. That prepared by Mott Souders, Jr., and G. G. Brown, on "Entrainment as a Factor in the Design of Fractionating Columns," aroused spirited discussion. W. H. Bahlke, of the Standard Oil Co. of Indiana, presented interesting data on the properties of hydrocarbons at high temperatures and pressures summarized by a solid three-dimensional model of a typical system in equilibrium over a range of temperatures, pressures, and compositions.

An interesting feature, following the informal dinner held May 5, was offered by Edward Mallinckrodt, Jr., who showed moving pictures of game animals taken in Alaska.

On the evening of May 6 the members and the general public heard L. V. Redman discuss "Economic Aspects of Research," an address illustrated by slides depicting the relations between returns on funds invested in various ways in research and development projects.

❖

Swann Corporation Opens New Sales Offices

ANNOUNCEMENT was made at the beginning of the month that, as the result of a business survey covering a large part of the United States, new sales offices are being opened in five of the large centers and sales representatives are being placed in ten other cities by the Swann Corp. The new offices are located in Boston, Baltimore, Pittsburgh, Charlotte, and Dallas. Sales representatives are being placed in Albany, Harrisburg, Camden, Cleveland, Louisville, Knoxville, Memphis, Atlanta, Jacksonville, and New Orleans.

❖

Procter & Gamble Will Build Plant in England

ANNOUNCEMENT was made a few days ago to the effect that the Procter & Gamble Co. has completed plans for the erection of a new soap plant at Manchester, England. For the last two years the Procter & Gamble Co. has held a controlling interest in a soap business at Newcastle-on-Tyne, operated under the name of Thos. Hedley & Co., Ltd. The latter company continued to manufacture its old lines, but several products of the American company were added and the volume of output has grown steadily in the two-year period.

MEN
IN CHEMICAL ENGINEERING

A. H. RICHARDS, for the past five years manager of the Tacoma (Wash.) smelter of the American Smelting & Refining Co., has been made Pacific Coast manager for the American Smelting & Refining Co., with headquarters in San Francisco. Mr. Richards has been with the company for 30 years.

KENNETH R. KINGSBURY, president of the Standard Oil Co. of California, has been appointed by the War Department as chief of the chemical warfare procurement district at San Francisco.

MILTON C. WHITAKER has been elected to the board of directors of the American Cyanamid Co. to fill the vacancy caused by the death of J. M. Selden, and has been appointed a vice-president of the company. Before joining the American Cyanamid Co. in 1930, Dr. Whitaker was a consultant and a vice-president of the U. S. Industrial Alcohol Co.

J. V. N. DORR, president of the Dorr Co., New York City, embarked for a trip to England, Germany, France and Holland on April 19, and will sail for home again on May 23.

MORTIMER JAY BROWN has resigned from the Roessler & Hasslacher Chemical Co., of which he was formerly vice-president and general superintendent, and also from the Pacific R. & H. Chemical Corp., of which he was executive vice-president.

ARTHUR W. WILKINSON has resigned as treasurer and general manager of the Sterling Products Co., Easton, Pa., of which he was co-founder 24 years ago.

A. E. MARSHALL, J. W. H. RANDALL, and FOSTER D. SNELL were elected chairman, treasurer, and secretary, respectively, of the American Section of the Society of Chemical Industry.

KARL GROSS, specialist in lead burning and coating, has joined the staff of the Northern Blower Co., Cleveland, Ohio.

E. P. HOLDER has been appointed by the American Machine & Metals, Inc., as vice-president and director of the Tolhurst Machine Works, in charge of operations.

EDWARD CURTIS FRANKLIN, professor emeritus of organic chemistry at Leland Stanford University, received the award of the Willard Gibbs medal to be bestowed on May 20 by the Chicago Section of the American Chemical Society. The distinction was made in consideration of Prof. Franklin's life-long study of liquid ammonia solutions in the organic chemical field.

MORTON IVERSEN, formerly research chemist of the Thomas A. Edison Laboratories, West Orange, N. J., has joined the Aerovox Wireless Corp., Brooklyn, N. Y., as chemist and assistant director of research.

ERNEST A. LESUEUR, chemical engineer, of Ottawa, Canada, whose pioneer contributions to the diaphragm

cell for sodium chloride electrolysis are the subjects of editorial comment on page 248 of this issue, was a recent visitor at *Chem. & Met.'s* offices.

DONALD F. OTHMER has been appointed instructor of chemical engineering at the Polytechnic Institute of Brooklyn.

❖

OBITUARY

JOHN D. TOLL, for many years connected with the fertilizer industry in official capacities, died at his home in Philadelphia, Pa., on April 22, after an attack of influenza. Mr. Toll began his career in the fertilizer industry as editor of *The American Fertilizer* in 1894. He filled this post until his death and thus was the only editor the journal has ever had. In 1910 he became chief of the educational bureau of the National Fertilizer Association and relinquished that position in 1916 to serve actively in many other branches of the organization. His record for service was unequalled by any other man in the industry.

JAMES MCCOBB SELDEN, president of the Selden Co., subsidiary of the American Cyanamid Co., died in Pittsburgh, Pa., on April 12 at the age of 68. A native of New York, Mr. Selden later made Pittsburgh his scene of activities and there founded the Selden Co. in 1917 for the manufacture of chemicals and processes. When this company was consolidated with the American Cyanamid Co. several years ago, he retained the active leadership as president.

WILFRED W. SCOTT, head of the department of chemistry of the University of Southern California, died on May 3 of a heart attack while driving his automobile. Dr. Scott was born 56 years ago in Zanesville, Ohio, and graduated from Ohio Wesleyan University in 1897. The next 13 years he devoted to further study and teaching at various schools and then joined the Baldwin Locomotive Works in 1910 as chief chemist. From 1911 to 1921, he was employed by the General Chemical Co. at New York, and thereupon became professor of chemistry at the Colorado School of Mines. He left there in 1925 to become professor of chemistry at the University of Southern California.

FRANCIS PITT SMITH, chemical engineer specializing in coal and asphalt chemistry, died on April 19, at his home in Mamaroneck, N. Y., at the age of 64, after an illness of more than a year. Mr. Smith was a graduate of the Columbia School of Mines and began work as inspector and assistant chemist of the New York Health Department. Later he was with the Consolidated Gas Co. and lecturer at Columbia and elsewhere. He was associated with numerous asphalt companies throughout his career and was considered an authority on the chemistry of asphalt for use in highway pavements.

JASPER M. ROWLAND, chief engineer of the Hooker Electrochemical Co., Niagara Falls, N. Y., died on April 6, after an appendicitis operation, at the age of 52. Mr. Rowland was born in New York City and educated at the Sheffield Scientific School of Yale University.

ALMOND L. CHESLEY, chief chemist of the American Tobacco Co. since 1920 and on its staff since 1912, died in New York City on April 28, at the age of 49.

CALENDAR

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, spring meeting, Schenectady and Corning, N. Y., June 15-17.

AMERICAN GAS ASSOCIATION, Atlantic City, June 3-4.

COLLOID SYMPOSIUM, American Chemical Society, Ottawa, Canada, June 16-18.

ELECTROCHEMICAL SOCIETY, fall meeting, Cleveland, Sept. 22-24.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Atlantic City, N. J., June 20-24.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, fall meeting, Holyoke, Mass., Sept. 14-16.

Report of Chemical Survey Made in Birmingham District

Comprehensive Study Suggests Possibility of Establishing New Manufacturing Lines

A CHEMICAL survey of the Birmingham (Ala.) district was recently completed by Dr. Stewart J. Lloyd, dean of the School of Chemistry, University of Alabama. The survey was carried on under the auspices of the Birmingham Industrial Board.

The plan of survey was intended to include (1) a succinct but clear account of the natural raw materials, mineral or otherwise, occurring in the district or sufficiently near it to be available, which are likely to be useful for chemical industry; (2) an account of what may be called "secondary" raw materials, such as manufactured gas, benzol, slag, etc., which themselves either serve or should serve as starting points for more complex materials; (3) a statement of the chemicals consumed in the district, with approximate quantities, and other such details as are desirable; (4) a statement of the chemicals actually made in the district; (5) a general view of the chemical industry in the district; and (6) a discussion of some chemical industries which logically belong in or near Birmingham but which are not yet established.

THE Birmingham district includes the cities of Bessemer, Tuscaloosa, Anniston, Gadsden, and Jasper. A circle with Birmingham as a center and a radius of 75 miles would cover it fairly well. The survey, however, and much of the statistics used deal with the entire state and at times with the whole southeast.

Coal, limestone, clays, shales, glass sand, iron ore, iron pyrites, graphite, mica, manganese, barytes, bauxite, amphibole variety of asbestos, and ocher are listed among the available raw materials. Their locations are spotted and descriptions given of their present state of commercial development. Cotton, corn, pine trees, sawdust and wood waste also are discussed from the viewpoint of chemical availability. Gypsum and salt are classified as important raw materials which are not found in nearby territories.

Secondary raw materials offered in quantities include slag, manufactured gas, coke, light oil, tar, naphthalene, phosphoric acid, and ammonia.

In setting down consuming requirements for the state a wide list of chemicals is enumerated, but in the majority of cases the tonnage involved is not large. In the absence of authoritative data, consumption figures do not in all cases refer to the same year and where recent figures were not procurable it has been necessary to go back to the last year for which reliable figures were available. The figures as compiled, however, offer a fair approximation of what may be regarded as normal consumption.

Among the chemicals consumed in a relatively large way were the following:

Sulphuric acid, 60 deg.	Tons	2,000,000
Sulphur	Tons	50,000
Sodium nitrate	Tons	30,800
Chemical lime	Tons	9,000
Ammonia as anhydrous	Tons	8,000
Nitric acid	Tons	12,000
Salt cake	Tons	25,000
Alcohol for chemicals	Gal.	40,000
Alum, true	Tons	500
Aluminum sulphate	Tons	3,000
Potassium nitrate	Tons	1,250
Calcium arsenate	Tons	4,000
Carbon dioxide	Tons	6,000
Lead arsenate	Tons	500
Caustic soda	Tons	3,000
Soda ash	Tons	5,750
Calcium carbide	Tons	1,250
Silicate of soda	Tons	325
Glaubers salt	Tons	200
Sal ammoniac	Tons	500

Sulphuric acid, which ranks first from a quantity standpoint, is produced at different plants in the state. Two explosive plants operate contact plants and consume their own output. Several plants produce chamber acid, which is used mainly in the fertilizer and steel industries. Sulphuric acid also is brought in from Tennessee. Two nitric-acid plants, operated for production of explosives, have a productive capacity of about 1,000 tons of 95 per cent acid a month. There is one producer of phosphoric acid of which the state consumes 4,900,000 lb. annually. Ammonia is made only in the byproduct coke plants and very largely converted into ammonium sulphate. Production could reach 21,500 tons of ammonia or 85,000 tons of sulphate, but these figures are 50 per cent higher than the production usually attributed to the district. An unknown quantity is marketed as ammonia liquor.

PERHAPS the most important result of the survey will be found in the deductions which Dr. Lloyd has made regarding the future developments of the district, particularly with reference to the establishment of new chemical industries. Touching on the alkali situation he says:

"The consumption of caustic soda in 1928 throughout Alabama was 3,000 tons. Georgia and Tennessee used 22,000 tons. Figures are not available for Louisiana, Mississippi, and Florida.

"The nearest point of supply is Saltville, Va., 400 miles from Birmingham. There is unquestionably sufficient demand to justify the building of an electrolytic caustic plant in some central location in the Southeast, where cheap power, salt, and fuel can be assembled. The new oil refinery at Mobile will be an additional consumer.

"The power and fuel exist together in the district, but the salt would have to be brought from Louisiana or Kansas, unless deposits are found above Mobile.

"The electrolytic process for caustic involves the production of chlorine, which cannot be thrown away, for obvious reasons, and some use must be found for it. The development of the sulphate pulp process in the Southeast, our most rapidly growing industry, one that has ridden out the depression almost at full speed, involves the use of large amounts of chlorine for bleaching and for disinfection in the mill. There is reason to believe also that chlorination of organic hydrocarbons, diphenyl, benzol, and naphthalene will require increasing amounts of chlorine year by year. The hydrogen made as a byproduct in the electrolytic process may find use in the hydrogenation of oils or be added to that used for synthetic ammonia. The case for soda ash is similar. Alabama used 5,750 tons and Georgia and Tennessee used 11,500 tons. Saltville, Va., is again the nearest point of supply. The production of glass will increase the consumption of soda ash.

"Probably the most conspicuous element lacking in the chemical picture of the Southeast today is the alkali industry in general."

HE next takes up the pulp and paper industry, which he describes as running nearer to 100 per cent capacity than any other, and discusses the large outlet thus offered for such chemicals as salt cake, alum, rosin, and lime. Salt cake, because of its large use is presented as a desirable chemical for an Alabama plant, with attendant hydrochloric acid output to be used in treating dolomite in the production of magnesium compounds. He expresses the opinion, however, that salt cake ultimately will be replaced in the paper industry by sodium sulphide.

Chemical byproducts from paper production are held out as offering possibilities, and Dr. Lloyd sees the building of an electrolytic chlorine plant as inevitable, with manufacture of aluminum chloride suggested as a means of utilizing the chlorine.

The report stresses the importance of the Southeast as an agricultural section with the consequent wide use of insecticides and other agricultural chemicals. While experience has proved production of a single product, such as calcium arsenate, is not desirable, a fairly full line of insecticides, however, is suggested as offering possibilities for favorable returns.

Referring to cottonseed oil, Dr. Lloyd points out that there is no refinery in the state and the establishment of one would involve the use of hydrogen for the hydrogation of the oil.

ECONOMIC INFLUENCES

on production and consumption of CHEMICALS

Slight Decline in Chemical Output Last Month

Productive Activities Varied According to Receptive Capacities of the Market

REPORTS on manufacturing activities within the chemical industry closely agree with those which refer to activities in the major consuming branches and it is apparent that attempts are being made to hold surplus stocks to a small volume. Recent reports have credited a falling off in production on the part of some consumers and these have been followed by similar reports with respect to producers of raw materials.

In verification of such reports, the index number for chemical production in April was reported at a slightly lower level than that for the preceding month. The index number is based on consumption of electrical energy within the chemical industry. With more complete returns the numbers for the first three months of the year have been revised, and production for the first four months of the year is represented as follows: January, 114.7; February, 114.9; March, 122.2; and April, 121.5. In each case the index number is below that representing the corresponding month of last year, which is an indication of the readjustment which has been made under the influence of lessened consuming demand.

Some encouragement has been found in preliminary reports of automobile production for April, which was considerably above that reported for March, and it is held that the settlement of the government budget will have a salutary effect on general business in the near future. The approach of the hot-weather period generally is regarded as pointing the way for a dull period in the chemical market, but the seasonal decline this year may be slight because of the contracted rate which has been in effect so far this year.

THE position of different branches of the chemical industry, producing and consuming, for the first quarter of this year in comparison with the corresponding period of last year is set forth in the accompanying table. As the season advances the decline in fertilizer consumption becomes more apparent and, taking tag sales as a basis of comparison, it is found that so far this year such sales have been materially under those for the corresponding month of 1931. The grand total of such sales for the first four months of this year is reported by the National Fertilizer Association at 3,565,805 tons, which compares with 5,002,106 tons for the four-month period of last year.

EXPORT trade in chemical products in March reached a valuation of a little more than 60 per cent of the total reported for March, 1931. For the first quarter of this year, exports were valued at $19,078,745, in comparison with $27,177,054 for the first quarter of last year. In the coal-tar group large gains were recorded for crude coal tar and coal-tar pitch, but exports of dyes and coloring matters were far below last year's totals.

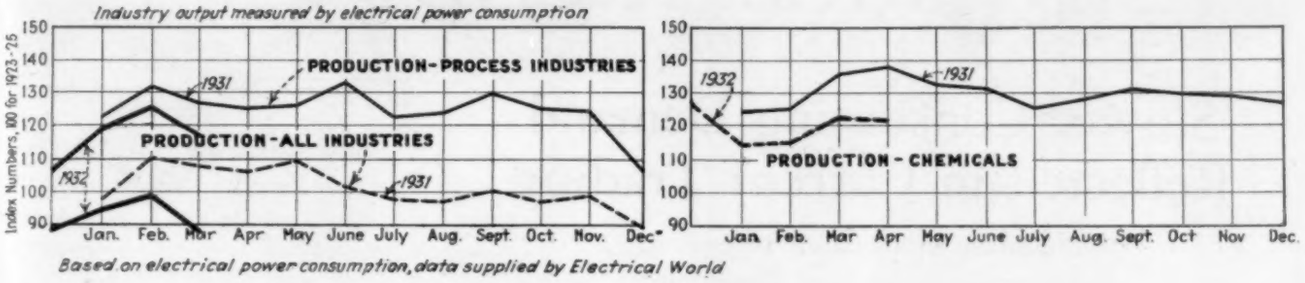
Sodium compounds were prominent in the export trade in the industrial chemical group, with total shipments for the quarter at 110,618,056 lb., compared with 123,921,693 lb. for the first quarter of 1931. Increases were made in the case of bichromate, borax, silicate, fluoride, and phosphate. Soda ash, sulphate, and bisulphate fell considerably below the 1931 figures. Caustic soda exports fell off more than 12 per cent.

Statistics for March indicate no trend toward larger volume of chemical imports. For the quarter, imports were valued at $13,727,933, in comparison with $26,976,343 for the like period of 1931. Imports of dyes and colors held up fairly well, but a noticeable drop was reported for creosote oil. Ammonium chloride and ammonium nitrate did not vary much in quantity from the amounts brought in last year. Copper sulphate imports for the quarter were 2,432,491 lb., and 790,376 lb. a year ago. Sodium cyanide was the only item in the soda group which came in in larger quantities this year.

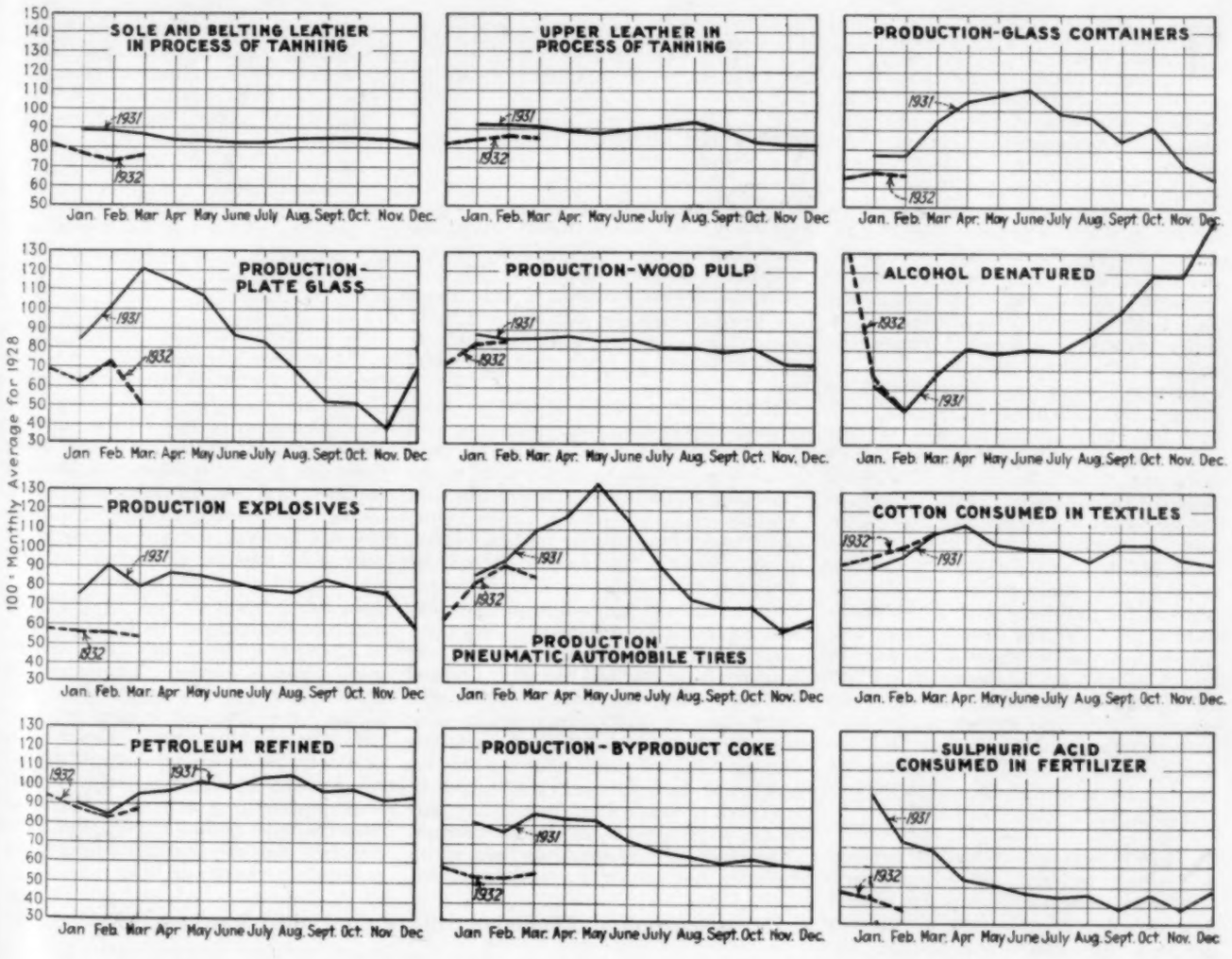
		First Quarter, 1932		First Quarter, 1931		Last Quarter, 1931	
		Production	Stocks, End of Quarter	Production	Stocks, End of Quarter	Production	Stocks, End of Quarter
Acetate of lime	1,000 lb.	10,981	8,913	22,548	28,687	5,916	8,734
Methanol, crude	Gal.	732,422	473,466	1,471,606	520,727	609,505	521,660
Methanol, refined	Gal.	371,630	293,065	783,011	499,978	285,833	225,706
Methanol, synthetic	Gal.	1,646,085	2,238,220	2,164,521	1,856,413	1,202,106	1,878,607
Alcohol, ethyl	1,000 pr. gal.	23,564[1]	12,574[2]	32,657	13,633	44,123	5,870
Alcohol, denatured	1,000 pr. gal.	15,839[1]	.....	23,172	.....	50,429	.....
Arsenic, crude	Ton	4,314	6,601	6,254	5,478	5,889	6,116
Arsenic, refined	Ton	2,713	4,379	4,485	2,181	3,478	4,295
Automobiles	Number	355,721	.....	668,193	.....	270,542	.....
Explosives	1,000 lb.	53,331	.....	78,221	20,929	68,386	18,712
Chemical wood pulp	Ton	354,248[1]	.....	550,826	34,858	483,556	36,434
Coke, byproduct	1,000 ton	6,186	3,473	9,246	2,825	6,899	4,322
Glass containers	1,000 gr.	3,154[1]	5,544[2]	5,719	5,974	5,388	5,855
Plate glass	1,000 sq.ft.	16,341	.....	22,517	.....	13,557	.....
Leather, sole and belting in process	1,000 lb.	186,886	.....	216,871	.....	204,799	.....
Leather upper, in process	1,000 sq.ft.	361,929	.....	386,347	.....	347,818	.....
Cottonseed oil, crude	1,000 lb.	519,710	129,328	396,062	69,878	765,621	126,761
Cottonseed oil, refined	1,000 lb.	453,495	682,487	397,991	494,503	659,225	489,866
Linseed oil	1,000 lb.	99,783	166,424	118,417	113,192	130,479	154,490
Soya bean oil, crude	1,000 lb.	14,629	18,481	9,086	16,654	10,655	13,635
Coconut oil, crude	1,000 lb.	77,887	191,389	91,446	201,932	68,702	188,352
Castor oil	1,000 lb.	9,700	11,401	12,213	6,634	11,882	11,887
Petroleum, refined	1,000 bbl.	199,640	.....	208,871	.....	220,443	.....
Pneumatic tires	1,000	8,804	.....	9,858	8,012	6,495	6,220
Sulphuric acid, by fertilizer trade	Ton	222,186	.....	494,141	121,275	315,187	95,038
Turpentine, gum, receipts at southern ports	Bbl.	15,232	73,640	22,093	45,232	73,840	112,311
Rosin, gum, receipts at southern ports	Bbl.	89,858	347,591	107,644	266,056	290,779	486,863
Turpentine, wood	Bbl.	11,076	5,835	16,131	9,987	11,202	6,002
Rosin, wood	Bbl.	69,389	90,540	90,364	125,919	70,784	92,258
Pine oil	Gal.	454,629	1,737	573,196	1,882	487,358	1,815
Consumption							
Cotton, in textiles	1,000 bales	1,374	1,566	1,329	1,478	1,306	1,631
Wool, grease equivalent	1,000 lb.	98,063	.....	112,649	.....	110,039	.....
Silk	Bales	151,463	27,157	165,535	22,231	155,745	24,651
Linseed oil, factory	1,000 lb.	59,167	.....	74,432	.....	57,354	.....
Fertilizer, in South	1,000 tons	1,181	.....	2,335	.....	227	.....

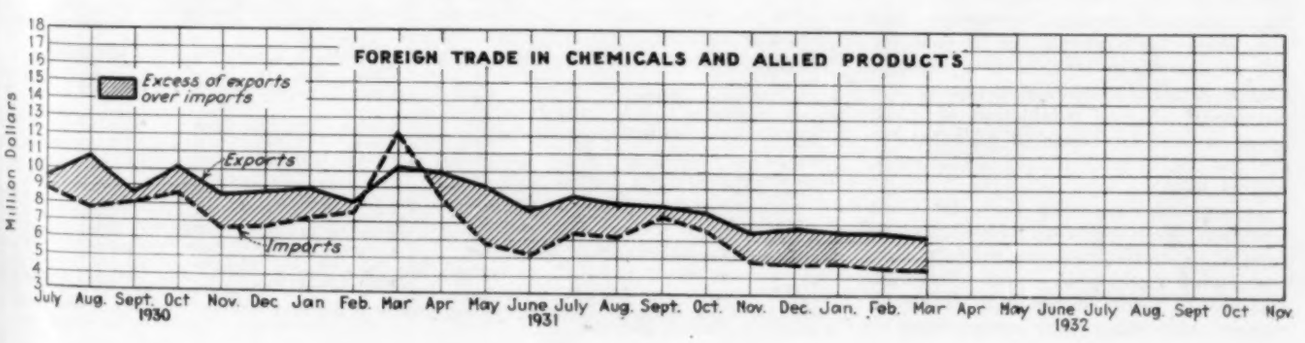
[1] Totals for January-February. [2] Stocks at end of February.

ACTIVITY IN PRODUCING AND CONSUMING INDUSTRIES


Industry output measured by electrical power consumption
Index Numbers, 100 for 1923-25
PRODUCTION-PROCESS INDUSTRIES
PRODUCTION-ALL INDUSTRIES
1931
1932
Jan. Feb. Mar Apr May June July Aug. Sept. Oct. Nov. Dec.
PRODUCTION-CHEMICALS
Jan. Feb. Mar Apr May June July Aug. Sept. Oct Nov Dec.

Based on electrical power consumption, data supplied by Electrical World




FOREIGN TRADE IN CHEMICALS AND ALLIED PRODUCTS
Million Dollars
Excess of exports over imports
Exports
Imports
July Aug. Sept. Oct Nov. Dec Jan Feb. Mar Apr May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar Apr May June July Aug. Sept Oct Nov
1930
1931
1932

MARKET CONDITIONS —AND PRICE TRENDS

Slower Consuming Demand Reflected in Current Trading

Curtailment of Inventories Tends to Create Improved Basic Condition

TRADING in chemicals during the past month has been largely of a routine nature with nothing in the way of price fluctuations or consuming demand deserving mention. The main feature to the market is the fact spot trading and deliveries against contract orders involve a smaller tonnage than was the case a year ago. Consuming industries not only are working at a reduced rate but likewise appear desirous of holding down inventories both of finished products and of raw materials. This tends to create a healthy basic condition but serves as a check, temporarily at least, on trading activities.

Statistics have just been issued on sales of paint, varnish, and lacquer products for March, and the value of such sales was given at $19,381,660, which compares with a value of $26,758,622 reported for March, 1931. Sales of plastic paints for the first quarter of the year amounted to 1,500,133 lb., with 2,658,392 lb. given for 1931. Calcimine sales for the same period involved 6,883,130 lb. this year and 8,738,658 lb. last year. Similar comparisons for cold-water paints show 2,791,857 lb. and 3,607,682 lb., respectively. While all consuming industries have not declined to the same extent as the paint industry, the general average is below that of last year and in consequence the demand for chemicals has been lowered accordingly.

NEWS bearing on market developments included an announcement that one chemical company was extending its sales organization by opening five new sales offices and placing sales representatives in ten additional centers; that another chemical company had completed the largest plant to date for the production of solid carbon dioxide; that a Southern chemical company had purchased the gas production of 2,678 acres of land in Texas at $225,000 for the gas rights and 4c. per 1,000 cu.ft. of fuel used.

It was also reported that the Corn Products Refining Co. had been successful in cultivating the growth of a species of tapioca in Santo Domingo and would begin production of starch there. This may offer competition to corn derivatives produced in this country but is also expected to curtail importations from foreign-producing points.

CONSIDERABLE reduction in turpentine production again this season is seen by the Department of Agriculture in reduced purchases of new turpentine cups by naval stores producers. Such sales for the 1932-33 season amounted to only 3,620,000. It was pointed out that the total is only about one-third the number sold in the 1930-31 season and is much below the 1923-31 average which approximated 18,650,000 cups.

Whale oil rendered aboard a Norwegian ship in Ross Sea, Antarctica, and delivered at New York is liable for duty as an importation from Norway, under a decision by the U. S. Court of Customs Appeals. Any other construction of the tariff law would result, said the court, in an absurdity and might permit destruction of the high seas fisheries of the United States. Imposition of the duty was contested by a domestic soap company which had contracted with the whaling company for the oil. Counsel for the company contended that the tariff law imposes duty only upon "merchandise when imported from any foreign country" and that neither the tariff nor international law could be stretched to define Ross Sea or any part of the high seas as a foreign country.

Sulphate of ammonia has been of interest in the market for some time because of the keen competition from abroad and the large increase in arrivals from European ports. This competition has depressed values, but last month there was a scarcity of spot and near-by supplies and buyers who entered the market were forced to pay high prices. Foreign material for later shipment was offered at low prices, so the situation was regarded as but temporary.

In this connection it is of interest to note a communication to the Department of Commerce which says that the upward trend of German ammonium sulphate exports, following the dissolution of the international nitrogen syndicate, has continued steadily. German exports of ammonium sulphate in the first two months of 1932 amounted to 86,907 tons, representing a gain of 9,000 tons over the same period of 1931, but 28,000 tons less than the shipments for the corresponding months of 1930.

New Coating for Metals Developed in Germany

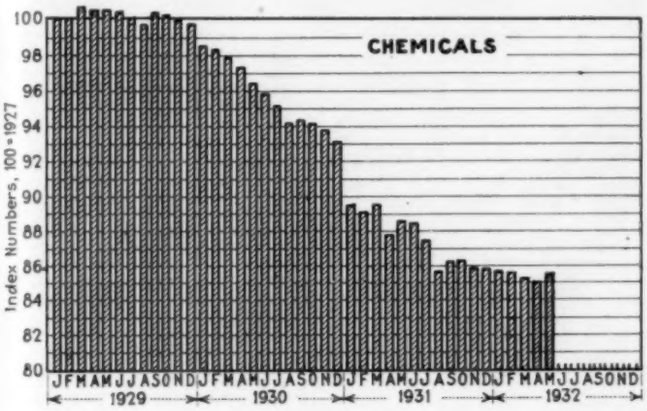
In a report from Frankfort-on-the-Main our consul general states that an invisible colorless protective coating for silver and other metals, intended to preserve their surface without subsequent painting or lacquering, has been invented by a German chemist. It is made from fossil resins such as amber or Congo copal, dissolved cold by a patented process. This coating is reported to preserve the original polish and color of the metal, besides preventing chemical changes, and is said to offer a fair measure of protection against abrasion and wear.

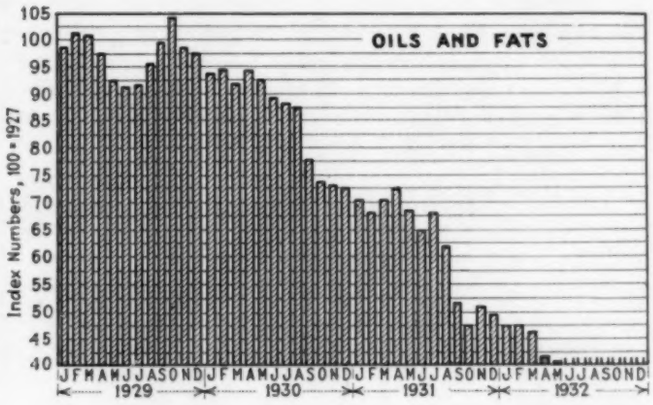
Production of Aluminum Salts in the United States in 1930-1931

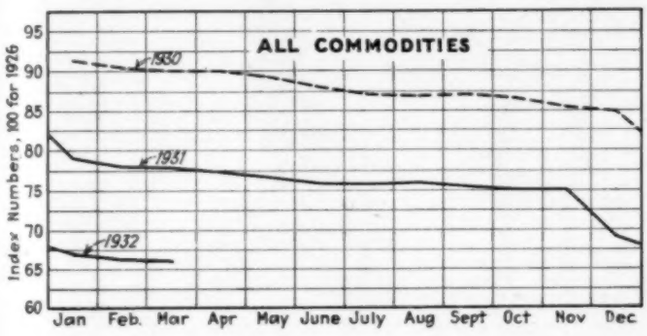
Salt	1930 Number of Producers Reporting	1930 Short Tons	1930 Value	1931 Number of Producers Reporting	1931 Short Tons	1931 Value
Alum						
Ammonia	5	4,076	$228,986	5	4,668	$251,066
Potash	3	1,923	104,818	3	2,086	111,168
Sodium aluminum sulphate	3	14,787	802,981	3	15,907	905,184
Aluminum chloride:						
Liquid	3	3,288	90,731	4	1,588	60,685
Crystal	3	583	53,363	2	5,533	560,175
Anhydrous	3	11,664	1,208,091	3		
Aluminum sulphate:						
Commercial —						
General	10	305,059	6,649,066	10	291,875	5,951,392
Municipal	9	10,300	172,671	10	11,509	193,450
Iron-free	7	18,177	642,247	7	15,108	483,060
Other aluminum salts and hydrate	4*	3,194	292,109	4*	2,797	219,850
Totals	..	373,051	$10,245,063	..	351,071	$8,736,030

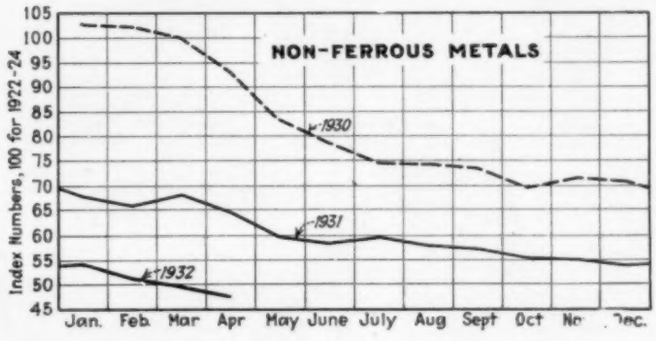
*In 1930: Three producers of alumina and one producer of sodium aluminate; 1931: two producers each of alumina and sodium aluminate.

CHEM. & MET. *Weighted Indexes of* PRICES









No Drastic Price Fluctuations Expected in Chemical Market

WHILE the weighted index number for chemicals recorded a fractional advance during the month, this was largely due to the influence of sulphate of ammonia, which was not readily available for spot delivery. As a result, prices for sulphate were sharply higher. In general, the market was devoid of important price fluctuations. Current values generally are regarded as having reached levels which are within close range of production costs. On the other hand, consuming activity has not responded to the usual seasonal influences, and lack of active buying and declines in the movement of contract holdings are, perhaps, the most important price factors at present. The quiet position of the market serves to check any trend toward an upward movement of prices and a protracted subnormal demand might influence some sellers to grant further price concessions as a stimulant to buying. The futility of price cutting merely as a competitive movement, however, has been clearly demonstrated in the last two years and, as production schedules now pay more heed to the variations in consuming outlets, the general level of values is more easily maintained. The price outlook, therefore, may be regarded as awaiting a change in buying interest, with a dragging market in prospect if consuming requirements are further contracted and a stronger market probable if demand improves.

Individual influences, as always, will affect individual commodities and main price fluctuations are likely to be found in cases where foreign-made chemicals offer competition.

Turpentine and rosin, after a short period of firmness, now show a downward trend which may not be checked before new lows have been established.

Vegetable oils continue to seek lower levels, and because of their interchangeability of use it is difficult to foresee improvement in any particular selection unless the entire market stages a recovery. A review of the stocks of oil on hand reveals an unfavorable statistical position and the weight of surplus holdings is a guarantee against any immediate rise in values.

The spring season usually finds crushers of linseed working at near capacity, but one mill was closed in the last few weeks because of inability to dispose of production.

A round lot of crude menhaden oil sold during the month at 15½c. a gallon, but holders of stocks say prices are nominal, as attempts to force sales would be successful only at material price reductions.

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1927

This month	**85.44**
Last month	85.01
May, 1931	88.62
May, 1930	96.54

Scarcity of spot supplies of sulphate of ammonia and the consequent advance in price had a strengthening effect on the weighted index number. Turpentine held an advance for a good part of the period, but closed below the level of the preceding month.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1927

This month	**40.40**
Last month	41.55
May, 1931	68.29
May, 1930	92.24

Price declines were fairly general throughout the vegetable oil market, but animal fats resisted further revisions. Stocks are still large and consuming demand has failed to record seasonal improvement.

CURRENT PRICES *in the* NEW YORK MARKET

THE following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to May 16.

Industrial Chemicals

	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.10 -$0.11	$0.10 -$0.11	$0.10.-$0.11
Acid, acetic, 28%, bbl., cwt.	2.65 - 2.90	2.65 - 2.90	2.60 - 2.85
Glacial 99%, tanks	8.89 -	8.89 -	8.98 -
drs.	9.14 - 9.39	9.14 - 9.39	9.23 - 9.48
U. S. P. reagent, c'bys.	9.64 - 9.89	9.64 - 9.89	9.73 - 9.98
Boric, bbl., lb.	.04½- .05	.04½- .05	.06½- .07
Citric, kegs, lb.	.32 - .32½	.32 - .32½	.37 - .38
Formic, bbl., lb.	.10 - .11	.10 - .11	.10 - .11
Gallic, tech., bbl., lb.	.50 - .55	.50 - .55	.50 - .55
Hydrofluoric 30% carb., lb.	.06 - .07	.06 - .07	.06 - .07
Latic, 44%, tech., light, bbl., lb.	.11½- .12	.11½- .12	.11½- .12
22%, tech., light, bbl., lb.	.05½- .06	.05½- .06	.05½- .06
Muriatic, 18° tanks, cwt.	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Nitric, 36°, carboys, lb.	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks., ton	18.50 -20.00	18.50 -	18.50 -20.00
Oxalic, crystals, bbl., lb.	.11 - .11½	.11 - .11½	.11 - .12
Phosphoric, tech., c'bys., lb.	.08½- .09	.08½- .09	.08½- .09
Sulphuric, 60°, tanks, ton	11.00 -11.50	11.00 -11.50	11.00 -11.50
Sulphuric, 66°, tanks, ton	15.50 -	15.50 -	15.50 -
Tannic, tech., bbl., lb.	.23 - .35	.23 - .35	.23 - .35
Tartaric, powd., bbl., lb.	.24 - .24½	.24½- .25	.30½- .33
Tungstic, bbl., lb.	1.40 - 1.50	1.40 - 1.50	1.40 - 1.50
Alcohol, ethyl, 190 p'f., bbl., gal.	2.53½-	2.53½-	2.33 -
Alcohol, Butyl, tanks, lb.	.113 -	.113-	.15½-
Alcohol, Amyl	-	-	-
From Pentane, tanks, lb.	.182-	.203-	.236-
Denatured, 188 proof			
No. 1 special dr., gal.	.34½-	.34½-	.27 -
No. 5, 188 proof, dr., gal.	.35½-	.35½-	.27 -
Alum, ammonia, lump, bbl., lb.	.03 - .04	.03 - .04	.03½- .04
Chrome, bbl., lb.	.04½- .05	.04½- .05	.04½- .05
Potash, lump, bbl., lb.	.03 - .04	.03 - .04	.03½- .04
Aluminum sulphate, com., bags, cwt.	1.25 - 1.40	1.25 - 1.40	1.25 - 1.40
Iron free, bg., cwt.	1.90 - 2.00	1.90 - 2.00	1.90 - 2.00
Aqua ammonia, 26°, drums lb.	.02½- .03	.02½- .03	.02½- .03
tanks, lb.	.02½- .02½	.02½- .02½	.02½- .02½
Ammonia, anhydrous, cyl., lb.	.15½- .15½	.15½- .15½	.15½- .15½
tanks, lb.	.05½-	.05½-	.05½-
Ammonium carbonate, powd. tech., casks, lb.	.10½- .11	.10½- .11	.10½- .11
Sulphate, wks., cwt.	1.25 -	1.00 -	1.75 -
Amylacetate tech., tanks, lb., gal.	.16 -	.16 -	.222-
Antimony Oxide, bbl., lb.	.06½- .08	.06½- .08	.08½- .10
Arsenic, white, powd., bbl., lb.	.04 - .04½	.04 - .04½	.04 - .04½
Red, powd., kegs, lb.	.09 - .10	.09 - .10	.09 - .10
Barium carbonate, bbl., ton	56.50 -58.00	56.50 -58.00	58.00 -60.00
Chloride, bbl., ton	63.00 -65.00	63.00 -65.00	63.00 -65.00
Nitrate, cask, lb.	.07 - .07½	.07 - .07½	.07 - .07½
Blanc fixe, dry, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Bleaching powder, f.o.b., wks., drums, cwt.	1.75 - 2.00	1.75 - 2.00	2.00 - 2.10
Borax, grain, bags, ton	40.00 -45.00	40.00 -45.00	50.00 -57.00
Bromine, cs., lb.	.36 - .38	.36 - .38	.36 - .38
Calcium acetate, bags	2.50 -	2.50 -	2.00 -
Arsenate, dr., lb.	.05½- .06½	.05½- .06½	.07 - .08
Carbide drums, lb.	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., wks., ton.	18.00 -	18.00 -	20.00 -
flake, dr., wks., ton.	21.00 -	21.00 -	22.75 -
Phosphate, bbl., lb.	.08 - .08½	.08 - .08½	.08 - .08½
Carbon bisulphide, drums, lb.	.05 - .06	.05 - .06	.05 - .06
Tetrachloride drums, lb.	.06½- .07	.06½- .07	.06½- .07
Chlorine, liquid, tanks, wks., lb.	.01½-	.01½-	.01½-
Cylinders	.04 - .06	.04 - .06	.04 - .06
Cobalt oxide, cans, lb.	1.25 - 1.35	1.25 - 1.35	1.75 - 1.85
Copperas, bgs., f.o.b. wks., ton.	13.00 -14.00	13.00 -14.00	13.00 -14.00
Copper carbonate, bbl., lb.	.07 - .16	.07 - .16	.08½- .18
Cyanide, tech., bbl., lb.	.39 - .44	.39 - .44	.41 - .46
Sulphate, bbl., cwt.	2.75 - 2.90	2.75 - 2.90	4.25 - 4.50
Cream of tartar, bbl., lb.	.19½- .19½	.19½- .19½	.23½- .24
Diethylene glycol, dr., lb.	.14 - .16	.14 - .16	.14 - .16
Epsom salt, dom., tech., bbl., cwt.	1.70 - 2.00	1.70 - 2.00	1.70 - 2.00
Imp., tech., bags, cwt.	1.15 - 1.25	1.15 - 1.25	1.15 - 1.25
Ethyl acetate, drums, lb.	.10 -	.10 -	.085-
Formaldehyde, 40%, bbl., lb.	.06 - .07	.06 - .07	.06 - .07
Furfural, dr., contract, lb.	.10 - .17½	.10 - .17½	.10 - .17½
Fusel oil, crude, drums, gal.	1.10 - 1.20	1.10 - 1.20	1.30 - 1.40
Refined, dr., gal.	1.80 - 1.90	1.80 - 1.90	1.90 - 2.00
Glaubers salt, bags, cwt.	1.00 - 1.10	1.00 - 1.10	1.10 - 1.20
Glycerine, c.p., drums, extra, lb.	.10½- .11	.10½- .11	.12½- .13
Lead:			
White, basic carbonate, dry casks, lb.	.06½-	.06½-	.07½-
White, basic sulphate, sck., lb.	.06 -	.06 -	.07 -
Red, dry, sck., lb.	.06½-	.06½-	.07½-
Lead acetate, white crys., bbl. lb.	.10 - .11	.10 - .11	.11 - .12
Lead arsenate, powd., bbl., lb.	.10 - .14	.10 - .14	.13 - .14
Lime, chem., bulk, ton	8.50 -	8.50 -	8.50 -
Litharge, pwd., csk, lb.	.05½-	.05½-	.06½-
Lithophone, bags, lb.	.04½- .05	.04½- .05	.04½ .05
Magnesium carb., tech., bags, lb.	.05½- .06	.05½- .06	.06 - .06½
Methanol, 95%, tanks, gal.	.33 -	.33 -	.33 -
97%, tanks, gal.	¾ -	.34 -	.34 -
Synthetic, tanks, gal.	.35½-	.35½-	.40½-
Nickel salt, double, bbl., lb.	.10½- .11	.10½- .11	.10½- .11
Single, bbl., lb.	.10½- .11	.10½- .11	.10½- .11
Orange mineral, csk., lb.	.09½-	.09½-	.09½-
Phosphorus, red, cases, lb.	.42 - .44	.42 - .44	.42 - .44
Yellow, cases, lb.	.31 - .32	.31 - .32	.31 - .32
Potassium bichromate, casks, lb.	.08 - .08½	.08 - .08½	.09 - .09½
Carbonate, 80-85%, calc., csk., lb	.05 - .05½	.05 - .05½	.05½- .06
Chlorate, powd., lb.	.08 - .08½	.08 - .08½	.08 - .08½
Cyanide, cs., lb.	.50 - .55	.55 - .57	.55 - .57
Hydroxide (c'stic potash) dr., lb.	.06½- .06½	.06½- .06½	.06½- .06½
Muriate, 80% bgs., ton	37.15 -	37.15 -	37.15 -
Nitrate, bbl., lb.	.05½- .06	.05½- .06	.05½- .06
Permanganate, drums, lb.	.16 - .16½	.16 - .16½	.16 - .16½
Prussiate, yellow, casks, lb.	.18½- .19	.18½- .19	.18½- .19
Sal ammoniac, white, casks, lb.	.04½- .05	.04½- .05	.04½- .05
Salsoda, bbl., cwt.	.90 - .95	.90 - .95	.90 - .95
Salt cake, bulk, ton	16.00 -18.00	16.00 -18.00	15.00 -18.00
Soda ash, light, 58%, bags, contract, cwt.	1.15 -	1.15 -	1.15 -
Dense, bags, cwt.	1.17½-	1.17½-	1.17½-
Soda, caustic, 76%, solid, drums, contract, cwt.	2.50 - 2.75	2.50 - 2.75	2.50 - 2.75
Acetate, works, bbl., lb.	.05 - .06	.05 - .06	.04½- .05
Bicarbonate, bbl., cwt.	1.85 - 2.00	1.85 - 2.00	1.85 - 2.00
Bichromate, casks, lb.	.05 - .06	.05 - .06	.07 - .07½
Bisulphate, bulk, ton	14.00 -16.00	14.00 -16.00	14.00 -16.00
Bisulphite, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Chlorate, kegs, lb.	.05½- .07½	.05½- .07½	.05½- .07½
Chloride, tech., ton	12.00 -14.75	12.00 -14.75	12.00 -14.00
Cyanide, cases, dom., lb.	.15½- .16	.15½- .16	.16½- .17
Fluoride, bbl., lb.	.07½- .08	.07½- .08	.08 - .09
Hyposulphite, bbl., lb.	2.40 - 2.50	2.40 - 2.50	2.40 - 2.50
Nitrate, bags, cwt.	1.77 -	1.77 -	2.05 -
Nitrite, casks, lb.	.07½- .08	.07½- .08	.07½- .08
Phosphate, dibasic, bbl., lb.	2.55 - 2.75	2.55 - 2.75	.0265 - .03
Prussiate, yel. drums, lb.	.11½- .12	.11½- .12	.11½- .12
Silicate (30°, drums), cwt.	.60 - .70	.60 - .70	.60 - .70
Sulphide, fused, 60-62%, dr., lb.	.02½- .03½	.02½- .03	.02½- .03
Sulphite, cyrs., bbl., lb.	.03 - .03½	.03 - .03½	.03 - .03½
Sulphur, crude at mine, bulk, ton	18.00 -	18.00 -	18.00 -
Chloride, dr., lb.	.03½- .04	.03½- .04	.05 - .06
Dioxide, cyl., lb.	.06½- .07	.06½- .07	.06½- .07
Flour, bag, cwt.	1.55 - 3.00	1.55 - 3.00	1.55 - 3.00
Tin bichloride, bbl., lb.	nom.-	nom.-	nom.-
Oxide, bbl., lb.	.26 -	.24½-	.26 -
Crystals, bbl., lb.	.23 -	.22½-	.24 -
Zinc chloride, gran., bbl., lb.	.06½- .06½	.06½- .06½	.06½- .06½
Carbonate, bbl., lb.	.10½- .11	.10½- .11	.10½- .11
Cyanide, dr., lb.	.38 - .42	.41 - .42	.41 - .42
Dust, bbl., lb.	.04½- .05	.04½- .05	.06 - .07
Zinc oxide, lead free, bag, lb.	.05½-	.05½-	.06½-
5% lead sulphate, bags, lb.	.05½-	.05½-	.06½-
Sulphate, bbl., cwt.	3.00 - 3.25	3.00 - 3.25	3.00 - 3.25

Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	$0.09½-$0.10½	$0.09½-$0.10	$0.10½-$0.11
Chinawood oil, bbl., lb.	.05½-	.06 -	.06½-
Coconut oil, Ceylon, tanks, N. Y. lb.	.03½-	.03½-	.04½-
Corn oil crude, tanks, (f.o.b. mill), lb	.02½-	.03½-	.07½-
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.02½-	.02½-	.06½-
Linseed oil, raw car lots, bbl., lb.	.06½-	.064-	.09 -
Palm, Lagos, casks, lb.	.03½-	.03½-	.05 -
Niger, casks, lb.	.03½-	.03½-	.04½-
Palm Kernel, bbl., lb.	.04½-	.04½-	.05½-
Peanut oil, crude, tanks (mill), lb	.02½-	.03½-	.07 -
Rapeseed oil, refined, bbl., gal.	.37 - .38	.37 - .38	.46 - .48
Soya bean, tank (f.o.b. Coast), lb	nom.-	nom.-	nom.-
Sulphur (olive foots), bbl., lb.	.04½-	.04½-	.05½-
Cod, Newfoundland, bbl., gal.	.25 - .27	.25 - .27	.42 - .45
Menhaden, light pressed, bbl., gal.	.30 - .32	.33 - .34	.34 - .36
Crude, tanks (f.o.b. factory), gal.	nom.-	nom.-	.20 -
Whale, crude, tanks, gal.	nom.-	nom.-	- nom.
Grease, yellow, loose, lb.	.02 -	.02 -	.03½-
Oleo stearine, lb.	.04 -	.04½-	.08½-
Red oil, distilled, d.p. bbl., lb.	.06½-	.06½-	.08½-
Tallow, extra, loose, lb.	.02½-	.02½-	.03½-

Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb.	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl., lb.	.80 - .85	.80 - .85	.80 - .85
Alpha-naphthylamine, bbl., lb.	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb.	.14½- .15	.14½- .15	.15 - .16
Aniline salts, bbl., lb.	.24 - .25	.24 - .25	.24 - .52

Coal-Tar Products (Continued)

	Current Price	Last Month	Last Year
Benzaldehyde, U.S.P., dr., lb.	$1.10 –$1.25	$1.10 –$1.25	$1.10 –$1.25
Benzidine base, bbl., lb.	.65 – .67	.65 – .67	.65 – .67
Benzoic acid, U.S.P., kgs, lb.	.48 – .52	.48 – .52	.57 – .60
Benzyl chloride, tech., dr., lb.	.30 – .35	.30 – .35	.30 – .35
Benzol, 90%, tanks, works, gal.	.20 – .21	.20 – .21	.20 – .21
Beta-naphthol, tech., drums, lb.	.22 – .24	.22 – .24	.22 – .24
Cresol, U. S. P., dr., lb.	.10½– .11	.10½– .11	.14 – .17
Cresylic acid, 97%, dr., wks., gal.	.49 – .52	.49 – .52	.54 – .58
Diethylaniline, dr., lb.	.55 – .58	.55 – .58	.55 – .58
Dinitrophenol, bbl., lb.	.29 – .30	.29 – .30	.29 – .30
Dinitrotoluen, bbl. lb.	.16 – .17	.16 – .17	.16 – .17
Dip oil 25% dr., gal.	.23 – .25	.23 – .25	.26 – .28
Diphenylamine, bbl., lb.	.38 – .40	.38 – .40	.38 – .40
H-acid, bbl., lb.	.65 – .70	.65 – .70	.65 – .70
Naphthalene, flake, bbl., lb.	.03½– .04½	.03½– .04½	.03½– .04½
Nitrobenzene, dr., lb.	.08½– .09	.08½– .09	.08½– .10
Para-nitraniline, bbl., lb.	.51 – .55	.51 – .55	.51 – .55
Para-nitrotoluine, bbl., lb.	.26 – .28	.26 – .28	.29 – .31
Phenol, U.S.P., drums, lb.	.14½– .15	.14½– .15	.14½– .15
Picric acid, bbl., lb.	.30 – .40	.30 – .40	.30 – .40
Pyridine, dr., lb.	1.50 – 1.75	1.50 – 1.80	1.50 – 1.80
R-salt, bbl., lb.	.40 – .44	.40 – .44	.40 – .44
Resorcinal, tech., kegs, lb.	.65 – .70	.65 – .70	1.15 – 1.25
Salicylic acid, tech., bbl., lb.	.33 – .35	.33 – .35	.33 – .35
Solvent naphtha, w.w., tanks, gal.	.26 –.....	.26 –.....	.25 – .30
Tolidine, bbl., lb.	.86 – .88	.86 – .88	.86 – .88
Toluene, tanks, works, gal.	.30 –.....	.30 –.....	.30 –.....
Xylene, com., tanks, gal.	.26 –.....	.26 –.....	.25 – .28

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton	$22.00–$25.00	$22.00–$25.00	$23.00–$25.00
Casein, tech., bbl., lb.	.06 – .10½	.06 – .10½	.07½– .11
China clay, dom., f.o.b. mine, ton	8.00 –20.00	8.00 –20.00	8.00 –20.00
Dry colors:			
Carbon gas, black (wks.), lb.	.02½– .20	.02½– .20	.03 – .20
Prussian blue, bbl., lb.	.35 – .36	.35 – .36	.35 – .36
Ultramine blue, bbl., lb.	.06 – .32	.06 – .32	.06 – .32
Chrome green, bbl., lb.	.27 – .28	.27 – .28	.27 – .30
Carmine red, tins, lb.	5.25 – 5.40	5.25 – 5.40	5.00 – 5.40
Para toner, lb.	.75 – .80	.75 – .80	.77 – .80
Vermilion, English, bbl., lb.	1.45 – 1.50	1.45 – 1.50	1.70 – 1.80
Chrome yellow, C. P., bbl., lb.	.16 – .16½	.16 – .16½	.16½– .17
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 – 7.50	6.50 – 7.50	6.50 – 7.50
Graphite, Ceylon, lump, bbl., lb.	.07 – .08½	.07 – .08½	.07 – .08½
Gum copal Congo, bags, lb.	.06 – .08	.06 – .08	.07 – .09
Manila, bags, lb.	.16 – .17	.16 – .17	.16 – .17
Damar, Batavia, cases, lb.	.16 – .16½	.16 – .19	.16 – .16½
Kauri No. 1 cases, lb.	.45 – .48	.45 – .48	.48 – .53
Kieselguhr (f.o.b. N.Y.), ton	50.00 –55.00	50.00 –55.00	50.00 –55.00
Magnesite, calc, ton	40.00 –.....	40.00 –.....	40.00 –.....
Pumice stone, lump, bbl., lb.	.05 – .07	.05 – .08	.05 – .07
Imported, casks, lb.	.03 – .40	.03 – .40	.03 – .35
Rosin, H., bbl.	3.95 –.....	4.10 –.....	6.35 –.....
Turpentine, gal.	.45 –.....	.44½–.....	.55½–.....
Shellac, orange, fine, bags, lb.	.25 – .27	.26 – .28	.38 – .40
Bleached, bonedry, bags, lb.	.18 – .19	.20 – .21	.30 – .31
T. N. bags, lb.	.10 – .11	.12 – .13	.16 – .17
Soapstone (f.o.b. Vt.), bags, ton	10.00 –12.00	10.00 –12.00	10.00 –12 00
Talc, 200 mesh (f.o.b. Vt.), ton	8.00 – 8.50	8.00 – 8.50	9.50 –.....
300 mesh (f.o.b. Ga.), ton	7.50 –10.00	7.50 –10.00	7.50 –11.00
225 mesh (f.o.b. N. Y.), ton	13.75 –.....	13.75 –.....	13.75 –.....

	Current Price	Last Month	Last Year
Wax, Bayberry, bbl., lb.	$0.16 –$0.20	$0.16 – $0.20	$0.20 –$0.22
Beeswax, ref., light, lb.	.25 – .27	.25 – .27	.28 – .30
Candelilla, bags, lb.	.13 –.....	.14 –	.14½– .15
Carnuba, No. 1, bags, lb.	.22½– .24	.21½– .24	nom.
Paraffine, crude			
105-110 m.p., lb.	.03½– .03½	.03½– .04½	.03½– .03¾

Ferro-Alloys

	Current Price	Last Month	Last Year
Ferrotitanium, 15-18%, ton	$200.00–.....	$200.00–.....	$200.00–.....
Ferromanganese, 78-82%, ton	72.00–75 00	72.00–75.00	80.00–85.00
Ferrochrome, 65-70%	.10– ...	.10–.....	.....
Spiegeleisen, 19-21% ton	27.00–.....	27.00–.....	30.00–.....
Ferrosilicon, 14-17%, ton	31.00–.....	31.00–.....	39.00–.....
Ferrotungsten, 70-80%, lb.	1.00– 1.10	1.00– 1.10	1.10–.....
Ferrovanadium, 30-40%, lb.	3.05– 3.40	3.05– 3.40	3.15– 3.50

Non-Ferrous Metals

	Current Price	Last Month	Last Year
Copper, electrolytic, lb.	$0.05½–.....	$0.05½–.....	$0.09 –.....
Aluminum, 96-99%, lb.	.23¾–.....	.23¾–.....	.23¾–.....
Antimony, Chin. and Jap., lb.	.05½–.....	.06 –.....	.06½–.....
Nickel, 99%, lb.	.35 –.....	.35 –.....	.35 –.....
Monel metal blocks, lb.	.28 –.....	.28 –.....	.28 –.....
Tin, 5-ton lots, Straits, lb.	.20¾–.....	.18½–.....	.22½–.....
Lead, New York, spot, lb.	.03 –.....	.03 –.....	.03½–.....
Zinc, New York, spot, lb.	.0275–.....	.0317–.....	.0335–.....
Silver, commercial, oz.	.28 –.....	.28½–.....	.28 –.....
Cadmium, lb.	.55 –.....	.55 –.....	.55 –.....
Bismuth, ton lots, lb.	.85 –.....	.85 –.....	1.50 –.....
Cobalt, lb.	2.50 –.....	2.50 –.....	2.50 –.....
Magnesium, ingots, 99%, lb.	.30 –.....	.30 –.....	.48 –.....
Platinum, ref., oz.	40.00 –.....	40.00 –.....	23.00–.....
Palladium, ref., oz.	19.00 – 21.00	19.00 – 21.00	19.00– 21.00
Mercury, flask, 75 lb.	67.00 –.....	73.00 –.....	101.00–.....
Tungsten powder, lb.	1.45 –.....	1.45 –.....	1.65–.....

Ores and Semi-finished Products

	Current Price	Last Month	Last Year
Bauxite, crushed, wks., ton	$6.50 –$8.25	$6.50 –$8.25	$6.50 –$8.25
Chrome ore, c. f , post, ton	17.00 –20.00	17.00 –20.00	19.50 –24.00
Coke, fdry., f.o b. ovens, t	3.25 – 3.75	3.25 – 3.75	2.75 – 2.85
Fluorspar, gravel, f.o.b. Il ., ton	17.25 –20.00	17.25 –20.00	17.25 –20.00
Manganese ore, 50% Mn., c.i.f. Atlantic Ports, unit	.25 – .26	.25 – .26	.25 – .27
Molybdenite, 85% MoS_2 per lb. MoS_2, N. Y., lb.	.45 –.....	.45 –.....	.35 – .40
Monazite, 6% of ThO_2, ton	60.00 –.....	60.00 –.....	60.00 –.....
Pyrites, Span. fines, c.i.f., unit	.13 –.....	.13 –.....	.13 –.....
Rutile, 94-96% TiO_2, lb.	.10 – .11	.10 – .11	.10 – .11
Tungsten, scheelite, 60% WO_3 and over, unit	10.00 –10.50	10.00 –10.50	12.00 –12.50

CURRENT INDUSTRIAL DEVELOPMENTS

New Construction and Machinery Requirements

❖

Aluminum Forging Plant — Wendell August Forge Inc., Grove City, Pa., has work under way on construction of 1 story aluminum forging plant at Madison Ave. Estimated cost $40,000. Private plans. Work by owner's forces.

Battery Plant — Exide Batteries of Canada Ltd., 153 Duffield St., Toronto, Ont., awarded contract for addition to plant to R. G. Kirby & Sons, 539 Yonge St., Toronto. Other contracts awarded.

Carbon Plant—Texas Elf Carbon Co., Pampa, Tex., awarded contract building and equipping plant unit consisting 80 x 60 ft. warehouse, 60 x 80 ft. cooling house, 60 x 312 ft. storage building to Cabot Shops, Inc., Pampa. $65,000. Machinery includes derricks, coolers, etc.

Plant — Canadian Carborundum Co. Ltd., Niagara Falls, Ont., awarded contract for two new additions to plant, 1 and 2 story, 92 x 112 and 48 x 140 ft., to Gardner Construction Co., Welland. One will be used for mixing and the other for fabricating abrasive products. $250,000.

Cement Manufacturing Plant — Consolidated Cement Co., Cement City, Mich., plans reconstruction of plant destroyed by fire. Estimated cost $50,000.

Cement Products Plant—John D. Gregg, Van Nuys, Calif., plans construction of a cement products plant near Van Nuys. Estimated cost $750,000.

Chemical Mixing House, etc.—Constructing Quartermaster, Fort Mason, San Francisco, Calif., having plans prepared for construction of a group of buildings, including chemical mixing house for treatment of diseased horses, 40 hp. high pressure boiler plant, etc., on Presidio St. Estimated cost $160.000.

Chemical Plant—Hoyt Bros., 100 Shipman St., Newark, N. J., awarded contract for 8 story, 75 x 85 ft. addition to plant for the manufacture of extracts, foods, polishes, cosmetics, etc., to Fassler Construction Co., Hill St., Newark. Estimated cost $150,000.

Chemical Plant—Jacques Wolf & Co., 350 Lexington Ave., Clifton, N. J., plans construction of a 2 story chemical plant on Lexington Ave. Estimated cost $40,000. Architect not announced. Maturity soon.

Chemical Plant—Southern Alkali Corp., c/o American Cyanamid Corp., 535 5th Ave., New York, N. Y., completed plans and site operations for chemical plant at Corpus Christi, Tex. Estimated total cost $10,000,000. Construction not yet started. Authorization to carry out original plans expected this fall or later.

Chemical Plant Addition—Richards Chemical Works, 190 Warren St., Jersey City, N. J., awarded contract for a 1 story, 100 x 200 and 57 x 100 ft. addition to chemical plant at 192-9 Warren St., to James Billington Inc., 198 Fairmount Ave., Jersey City, $40,000.

Chemical Storage Building—Electro Chemical Engraving Co., 1100 Brook Ave., New York, N. Y., plans construction of a chemical storage building. $40,000. Maturity indefinite.

Copper Works—Raritan Copper Works, Perth Amboy, N. J., plans reconstruction of plant destroyed by explosion including installation of boiler house, boiler, etc., at Elm and Market Sts. Estimated cost to exceed $40,000.

Cotton Oil Mill—Southern Cotton Oil Co., Canal Bank Bldg., New Orleans, La., is considering rebuilding plant at Goulding near Pensacola, Fla., destroyed by fire. Loss $100,000.

Drug and Chemical Manufacturing Plant—Merck & Co., Lincoln Ave., Rahway, N. J., awarded contract for a 1 and 2 story addition to plant on Lincoln Ave. to Robert E. Lamb, 841 North 19th St., Philadelphia, Pa. Exceeds $150,000. Other contracts let.

Drug Warehouse—Hudson River Holding Corp. c/o H. Watson, Eureka Garage, Ludlow and Bridge Sts., Yonkers, N. Y., plans converting garage into drug distribution warehouse. Estimated cost to exceed $40,000 including equipment. McKesson-Eisen Drug Co., 79 Cliff St., New York, lessee.

Plant—The Murine Co. Inc., 9 East Ohio St., Chicago, Ill., manufacturers of toilet articles, having plans prepared for a 2 story plant 25,000 sq.ft. at Berteau and East Ravenswood Sts. Estimated cost $100,000. Architect not selected.

Fertilizer Manufacturing Plant — Societe le Sulfurophosphate, Paris, France, plans construction of a fertilizer manufacturing plant at Plymouth, England, production to exceed 15,000 tons. Estimated cost $200,000.

Glass Warehouse—Glenshaw Glass Co., A. Berner, Pres., Lower Road, Glenshaw, Pa., plans to rebuild 1 story glass warehouse destroyed by fire. Loss $100,000 to $200,000. Private plans. Maturity soon.

Laboratory—Flake-Ice Corp., 205 Water St., Brooklyn, N. Y., leased premises at 574 Ferry St., Newark, N. J., and plans alterations and equipment for machine shop and laboratory building.

Laboratory — Massachusetts College of Pharmacy, 179 Longwood Ave., Boston, Mass., awarded contract for 4 story, 42 x 68 ft. addition to college building including chemistry laboratory, etc., to Chase & Gilbert, Inc., 31 St. James Ave., Boston.

Laboratory, etc.—Junta de Fomento, Municipality of San Salvador, El Salvador, plans to expend $3,500,000 on construction program including University and Medical School laboratory, post office, etc.

Laboratory Buildings, etc. — McGill University, Montreal, Que., plans neurological institute, hospital and laboratory buildings. Estimated cost $1,000,000. Project will be financed largely from $1,232,000 gift of Rockefeller Institute, 61 Broadway, New York. Owner in charge of construction.

Laboratory (Physical Science)—Smith College, Northampton, Mass., plans construction of a group of college buildings including physical science building, library addition, dormitories, etc. Estimated cost to exceed $3,000,000.

Laboratories—Board of Education, 911 Locust St., St. Louis, Mo., will soon receive bids for construction of a 3 story, 400 x 500 ft. high school including laboratories, etc., at Kingshighway and Arsenal St. Estimated cost $900,000. E. T. Friton, Building Comr., c/o Board of Education.

Laboratories—Treasury Department, Office of J. A. Wetmore, Acting Supervising Architect, Washington, D. C., will receive bids until May 27 for addition and remodeling of marine hospital, including X-ray department, laboratories, etc., on Clarendon Ave. Estimated cost $500,000. Thielbar & Fugard, 520 North Michigan Ave., Chicago, Ill., are architects.

Magazine Buildings—Constructing Quartermaster, Maxwell Field, Montgomery, Ala., will receive bids until May 31 for construction and completion of seven standard magazines at Maxwell Field.

Mine — Western Syndicate represented by Marshall Haney, Mining Engineer, Geer, Virginia, purchased Crinova Manganese Mine near Crinova, Augusta County. Ore will be used by furnaces along the Ohio and Mississippi Rivers and amount to be expended on improvements including possibly an electric furnace not decided.

Paint Manufacturing Plant—J. J. Hoehenjos Co., 829 Broad St., Newark, N. J., will soon award contract for construction of a 3 story paint manufacturing plant on Frelinghuysen Ave. Estimated cost $40,000. Henry D. Scudder, Jr., 9 Clinton St., Newark, is architect.

Paint and Varnish Plant — Union Socialist Soviet Republics, c/o Amtorg Trading Corp., 261 5th Ave., New York, will build a plant for production of powdered and enamel paints, oil varnishes and dryers at Cheliabinsk (Urals). Estimated cost to exceed $1,000,000. Work will be done by technical aid contracts.

Paper Manufacturing Plant—Hinde & Dauch, 253 Water St., Sandusky, O., awarded contract for construction of a 1 story, 160 x 700 ft. paper manufacturing plant at Monroe and Madison Sts., Hoboken, N. J., to Otto Randolph Inc., 53 West Jackson Blvd., Chicago, Ill. Estimated cost $400,000.

Paper Plant—Consolidated Power & Paper Corp., Port Alfred, Que., plans to rebuild part or all of fire damaged property including yards, timber storage for pulp manufacturing, transportation facilities, etc. Loss exceeds $3,000,000.

Paper Plant—Kaehler Paper Co., 2526 West Oak St., Blue Island, Ill., awarded general contract for a 1 story warehouse to William Mancke, 6769 174th St., Tinley Park, Ill. Estimated cost $40,000.

Paper Plant—West Carrollton Parchment Co., West Carrollton, O., awarded contract for addition and extensions to paper mill to Charles H. Shook, c/o owner. Estimated cost $40,000.

Paper Manufacturing Plant—Chaney Pulp & Paper Co., Franklin, O., plans reconstruction of plant and boiler house destroyed by explosion.

Paper Manufacturing Plant—S. D. Warren Co., Westbrook, Me., plans reconstruction of paper manufacturing plant and storage building destroyed by fire. Estimated cost to exceed $100,000.

Refinery—General Manganese Co., 155 West Congress St., Detroit, Mich., plans construction of first unit of refinery at Sioux Falls, S. D. Estimated cost $200,000.

Refinery—Magnolia Petroleum Co., Beaumont, Tex., plans reconstruction of a refinery destroyed by fire. Also awarded contract for refinery, cracking still, and furnaces at Fort Worth to M. W. Kellog Co., 225 Broadway, New York. Estimated cost $150,000 and $40,000 respectively. Maturity indefinite.

Refinery—Minister of Agriculture de Tomaso, Buenos Aires, Argentina, awarded contract for two refining units for preparation of lubricants and other distillates at La Plata to Alco Products Co., 220 East 42nd St., New York.

Refinery—Northwest Stellarence Co., Coutts, Alta., will soon award contract for reconstruction of refinery including equipment, etc. Estimated cost $150,000.

Refinery—Valley Refining Co., c/o W. K. Campbell, McAllen, Tex., will build a refinery near McAllen, capacity 500 bbl. of crude oil and 100 bbl. of lubricating oil. Plans include installation of a skimming and blending unit, later will add a cracking unit. Estimated cost $40,000. Work under supervision of owners.

Refinery (Oil) — Associated Oil Co., Avon, Calif., awarded contract for construction of an oil refinery to Foster Wheeler Co., 165 Broadway, New York, N. Y. Estimated cost to exceed $40,000.

Refinery (Oil) — Imperial Oil Co. Ltd., 56 Church St., Toronto, Ont., subsidiary of Standard Oil Co. of New Jersey, 26 Broadway, New York, N. Y., plans construction of a petroleum refinery in vicinity of Cartagena, Colombia, South America. Estimated cost to exceed $1,000,000. Project is dependent upon tariffs and restrictions upon oil importations into United States.

Refinery (Oil)—Major Oil & Refining Co., c/o H. C. Fox, 2329 North Flynn, Oklahoma City, Okla., plans re-equipment of oil refinery. Cost to exceed $40,000.

Refinery (Oil)—Pure Oil Co., Midland, Mich., awarded contract for design and construction of an oil refinery at Midland to Alco Products Co., 220 East 42nd St., New York. Estimated cost to exceed $350,000.

Rubber Plant—Plymouth Rubber Co., Canton, Mass., manufacturers of rubberized cloth, plans construction of a warehouse and reclaiming plant. Estimated cost $40,000. Maturity indefinite.

Silk and Rayon Plant—Crompton & Knowles Loom Works, Providence, R. I., leased former plant of Old Anchor Webbing Co. at Pawtucket and will re-equip for the manufacture of silk and rayon textiles. Some new equipment will be purchased and some moved from other plants. $40,000.

Soap Factory—Lever Bros. Co., 164 Broadway, Cambridge, Mass., awarded contract for a 2 story addition to plant including laboratory and tower to R. LeRoy Fox Inc., 101 Milk St., Boston. Estimated cost $40,000.

Soap Manufacturing Plant—Proctor & Gamble Co., Gwynne Bldg., Cincinnati, O., will soon let contract for construction of a soap manufacturing plant including equipment at Manchester, England. Estimated cost to exceed $500,000.

Sulphate of Aluminum, Lime, etc.—City Commission, New Brunswick, N. J., will receive bids until May 24 for 100 tons sulphate of aluminum, 60 tons hydrated lime, 18,000 liquid chlorine, 5,000 lb. anhydrous ammonia and 20 tons soda ash.

Sugar Refinery—National Sugar Refining Co., 55th Ave. and Second St., Long Island City, N. Y., plans alterations to power house, at 56th Ave. and Second St. Estimated cost to exceed $25,000. L. T. Bromfield, c/o owner, is architect.

Tar and Roofing Products—Barrett Co., 40 Rector St., New York, N. Y., acquired site and plans construction of a tar and roofing products plant at Malden, Mass. Estimated cost $100,000.

INDUSTRIAL NOTES

PFAUDLER CO., Rochester, N. Y., has appointed Fred B. Morris as special sales representative.

MORRIS MACHINE WORKS, Baldwinsville, N. Y., has now located at the New York office at 30 Church St.

ALCO PRODUCTS, INC., New York City, has opened a branch office at the Rialto Building, San Francisco, Calif., under R. S. Danforth.

AMERICAN MANGANESE BRONZE CO., Holmesburg, Pa., has purchased the assets of PAUL F. REEVES & CO. and CASKEY BRASS & BRONZE CO.

ORVILLE SIMPSON CO., Cincinnati, Ohio, has appointed the Cleveland Duplex Machinery Co., Inc., representative at Penton Bldg., Cleveland, Ohio.

PITTSBURGH EQUITABLE METER CO. has become consolidated with MERCO NORDSTROM VALVE CO., which will operate as a division of the former under the presidency of W. F. Rockwell.

MUNDET CORK CORP., New York City, has placed R. H. Hunter in charge of its branch at Memphis, Tenn.

SULLIVAN MACHINERY CO., Chicago, Ill., has moved its branch office at Knoxville, Tenn., to the Medical Arts Building.

ZAREMBA CO., Buffalo, N. Y., and D. P. SPERRY & CO., Batavia, N. Y., announce that their New York representative, H. E. Jacoby, has moved his offices to 205 East 42d St.

UNIVERSAL OIL PRODUCTS CO., Chicago, Ill., has moved its New York offices to 50 Broadway.

CHLORINE INSTITUTE has changed its address to 50 East 41st St., New York City.

GRISCOM-RUSSELL CO. has moved its Dallas (TEXAS) office to Power Petroleum Building.

AMERICAN UTENSIL CO., Chicago, Ill., has moved its offices to its plant at 319 West Ohio St.

T. H. GOLDSCHMIDT CORP., New York City, has moved its office to the Cities Service Building, 70 Pine St.